Ohio Agricultural Experiment Station.

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PLANS AND SUMMARY TABLES

OF THE EXPERIMENTS AT THE CENTRAL FARM, WOOSTER, AND THE NORTHEASTERN TEST FARM, STRONGSVILLE

ON THE

MAINTENANCE OF SOIL FERTILITY

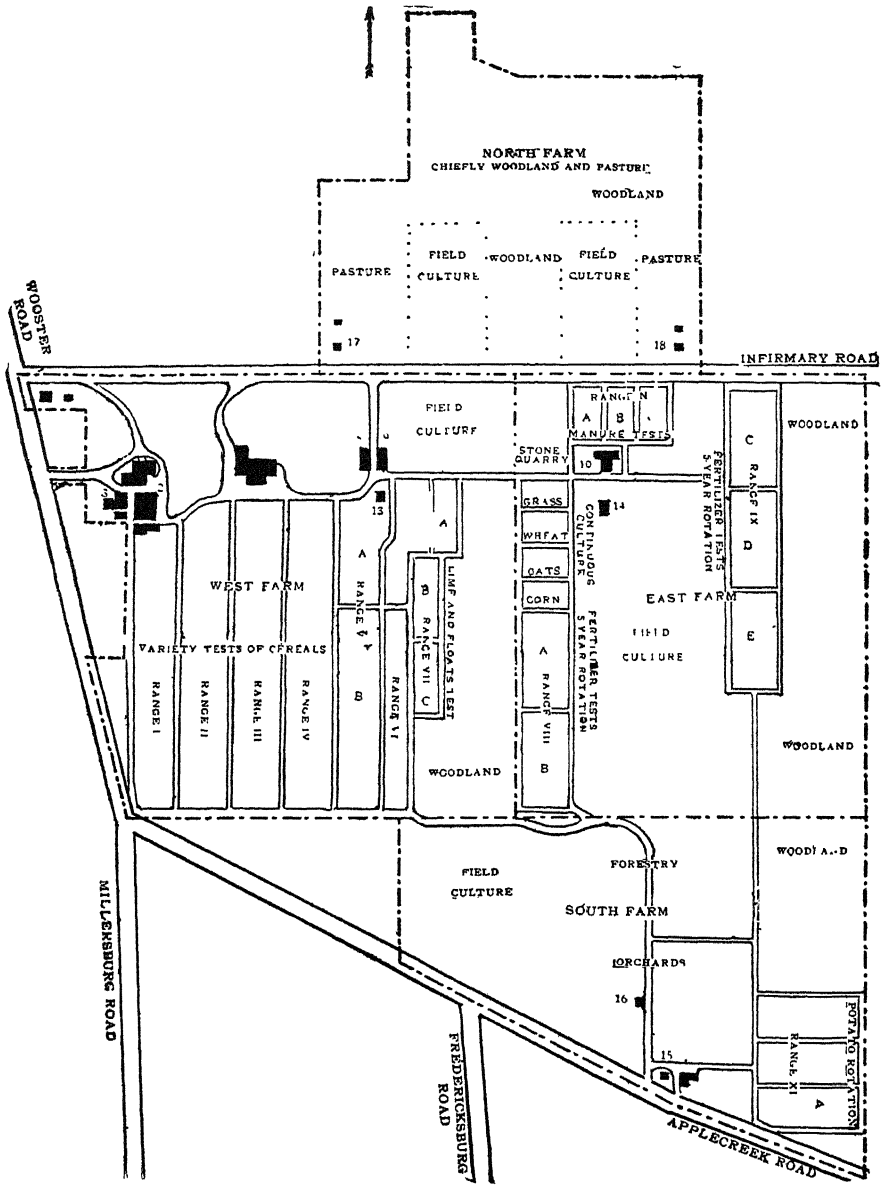
ARRANGED FOR REFERENCE IN THE FIELD

ANNOUNCEMENT

The experiments reported in the following pages were begun in 1893, immediately after the removal of the Experiment Station to Wayne county. The general plan of this work and the results obtained up to that time are published in Bulletin 110, issued in December, 1899, (now out of print) and again in Bulletins 182, 183, and 184, reporting to the end of 1906. It now seems desirable to follow these general publications with an annual statement, giving as briefly as possible the new data from each successive crop, and referring the reader to Bulletins 182 and 183 for more complete information respecting the nature of the soils under experiment and the general plan of the work, and to Bulletin 184 for the statistics of crop yields for the years 1894 to 1906, inclusive.

The results at Wooster for 1907 are given in Circular No. 83, those for 1908 in Circular No. 92, those for 1909 in Circular No. 104, those for 1910 in Circular No. 114, those for 1911 in Circular No. 120, those for 1912 in Circular No. 131, and those for 1913 in the present circular.

The results at Strongsville are given in Bulletins 182 and 184 for the earlier years of the work, those for the years 1906 to 1911 inclusive in Bulletin 260, those for 1912 in Circular No. 131, and those for 1913 in the present circular.



The central farm, near Wooster
(470 acres)

THE WOOSTER EXPERIMENTS

I: FERTILIZERS AND MANURE ON CROPS GROWN CONTINUOUSLY ON THE SAME LAND

Wheat, oats and corn, one acre (10 plots) each, have been grown in this experiment since 1894. The fertilizers are applied to Plots 2 and 8 in arbitrary quantities, while on Plots 3 and 9 the three fertilizing elements, nitrogen, phosphorus and potassium, are given in approximately the same ratio to each other in which they are found in the plant.

The applications to Plots 2 and 8 have in every case produced larger average yields than those to Plots 3 and 9, but this may in part be accounted for by the combined nitrogen which is carried to the soil in rain, thus enabling the crops grown on 2 and 8 to utilize larger quantities of the phosphorus and potassium given in the fertilizer than that required merely to balance the fertilizer nitrogen.

The manure applications on Plots 5 and 6 were intended to carry nitrogen in quantities equivalent to the applications on Plots 2 and 3 on the one hand and 8 and 9 on the other, estimating the manure to carry 10 pounds of nitrogen per ton, but actual analyses of manure made during recent years indicate that this estimate was too high for open yard manure, such as is used in these tests. The average application of phosphorus and potassium in the manure closely approximates the average given to the four fertilized plots.

In this test the corn and wheat show a rapid falling off in yield on the unfertilized land during recent years. The oats also show a reduction in yield, but not so great as that of the other crops.

It is much more difficult to control the weed growth in the wheat and oats grown continuously than where same crops are grown in rotation, and it was necessary a few years ago to divide these tracts and fallow the two ends in alternate seasons in order to destroy the weeds. Latterly the entire plots have been cropped again.

Diagram I shows the arrangement of plots and plan of fertilizing in this experiment, and the general outcome is shown in Tables I and II, which give the yields by periods.

In calculating the increase in the following tables, it is assumed that variations in the soil are progressive and that if the yields on Plots 1 and 2 were 6 and 9 bushels, respectively, Plots 2 and 3 should have yielded 7 and 8 bushels, respectively, if left unfertilized. While, of course, this regular variation will not always occur, experience has shown that in general this method of computation most nearly approximates the true result.

DIAGRAM 1: PLAN OF FERTILIZING IN CONTINUOUS CULTURE

PLOTS ONE-TENTH ACRE

		Fertilizing materials in pounds per acre
Wheat	1	None
	2	Acid phos., 160; muriate potash, 100; nitrate soda, 120; dried blood, 50*
	3	Acid phos., 45; muriate potash, 30; nitrate soda, 120; dried blood, 50*
	4	None
	5	Yard manure, 2½ tons
	6	Yard manure, 5 tons
	7	None
	8	Acid phos., 160; muriate potash, 100; nitrate of soda, 280; dried blood, 50**
	9	Acid phos., 90; muriate potash, 60; nitrate of soda, 280; dried blood, 50**
	10	None
Oats	1	None
	2	Acid phos., 160; muriate potash, 100; nitrate soda, 160
	3	Acid phos., 55; muriate potash, 50; nitrate soda, 160
	4	None
	5	Yard manure, 2½ tons
	6	Yard manure, 5 tons
	7	None
	8	Acid phos., 160; muriate potash, 100; nitrate soda, 320
	9	Acid phos., 110; muriate potash, 100; nitrate soda, 320
	10	None
Corn	1	None
	2	Acid phos., 160; muriate potash, 100; nitrate soda, 160
	3	Acid phos., 60; muriate potash, 30; nitrate soda, 160
	4	None
	5	Yard manure, 2½ tons
	6	Yard manure, 5 tons
	7	None
	8	Acid phos., 160; muriate potash, 100; nitrate soda, 320
	9	Acid phos., 120; muriate potash 60; nitrate soda, 320
	10	None.

(South)

*120 pounds nitrate of soda plus 50 pounds dried blood is equivalent to 160 pounds nitrate of soda.
**280 pounds nitrate of soda plus 50 pounds dried blood is equivalent to 320 pounds nitrate of soda.

TABLE I: CROPS GROWN IN CONTINUOUS CULTURE. Yield and increase for 1913 and average annual yield for 20 years, 1894-1913

Plot No.	Fertilizing materials Pounds per acre	1913 Yield Grain Bus.	1913 Yield Stover or straw Lbs.	1913 Increase Grain Bus.	1913 Increase Stover or straw Lbs.	20 years, 1894-1913 Yield Grain Bus.	20 years, 1894-1913 Yield Stover or straw Lbs.	20 years, 1894-1913 Increase Grain Bus.	20 years, 1894-1913 Increase Stover or straw Lbs.	Plot No.
	Corn									
1	None	15.75	1,260	.....	...	20.99	1,430	.....	...	1
2	Acid phosphate, 160; muriate potash, 100; nitrate soda, 160	33.93	1,900	21.67	743	41.68	2,324	22.60	960	2
3	" " 60; " " 30; " " 160	23.53	1,550	14.73	497	33.19	1,936	16.01	639	3
4	None	5.29	950	.....	...	15.28	1,231	.....	...	4
5	Yard manure, 2½ tons	15.96	1,390	10.86	420	27.08	1,761	12.14	541	5
6	" " 5 "	25.32	1,880	20.42	890	37.02	2,141	22.41	931	6
7	None	4.71	1,010	.....	...	14 28	1,200	... .	...	7
8	Acid phosphate, 160; muriate potash, 100; nitrate soda, 320	39.14	2,070	34.35	1,113	46.84	2,412	33.54	1,273	8
9	" " 120; " " 60; " " 320	37.54	1,920	32.66	1,017	44.15	2,268	31.83	1,190	9
10	None	4.96	850	.....	.....	11.34	1,017	... .	... .	10
	Average unfertilized yield	7.68	1,017	.....	.....	15.47	1,234	.....	.....	
	Oats									
1	None	12.27	697	... .	...	19.89	785	... .	.....	1
2	Acid phosphate, 160; muriate potash, 100; nitrate soda, 160	24.53	1,660	12.97	982	40.56	1,935	19.95	1,117	2
3	" " 55; " " 50; " " 160	21.33	1,287	10.46	628	36.72	1,633	15.38	784	3
4	None	10.16	640	.....	...	22.07	882	.....	...	4
5	Yard manure, 2½ tons	17.11	1,107	6.74	304	30.12	1,266	7.81	345	5
6	" " 5 "	20.00	1,522	9.43	555	37.38	1,806	14.84	847	6
7	None	10.78	1,130	....	...	22.78	999	.....	...	7
8	Acid phosphate, 160; muriate potash, 100; nitrate soda, 320	30.62	2,155	18.12	1,111	46.55	2,480	23.44	1,486	8
9	" " 110; " " 100; " " 320	27.42	1,932	13.20	974	44.70	2,333	21.24	1,344	9
10	None	15.94	872	... .	...	23.79	984	.....	.....	10
	Average unfertilized yield	12.29	835	.....	...	22.39	917	.....	.....	
	Wheat									
1	None	6.41	1,005	.....	.....	7.37	1,049	.....	.....	1
2	Acid phos., 160; mur. potash, 100; nit. soda, 120; dried blood, 50	19.83	2,420	12.39	1,403	19.09	2,471	11.52	1,455	2
3	" " 45; " " 30; " " 120; " " 50	21.75	3,025	13.28	1,997	15.33	1,890	7.56	907	3
4	None	9.50	1,040	.....	.....	7.97	950	.....	.....	4
5	Yard manure, 2½ tons	16.08	2,015	6.77	950	13.46	1,715	5.54	755	5
6	" " 5 "	21.42	2,825	12.31	1,735	17.62	2,242	9.73	1,275	6
7	None	8.92	1,115	.....	.....	7.85	976	.....	.....	7
8	Acid phos., 160; mur. potash, 100; nit. soda, 280; dried blood, 50	27.71	3,867	19.93	2,844	22.22	2,908	14.69	1,977	8
9	" " 90; " " 60; " " 280; " " 50	24.62	2,932	17.98	2,000	20.16	2,457	12.96	1,571	9
10	None	5.50	840	.....	....	6.89	840	.....	.....	10
	Average unfertilized yield	7.58	1,000	.....	.....	7.52	941	.....	.....	

TABLE II: CROPS GROWN IN CONTINUOUS CULTURE. Average annual yield and increase per acre by 5-year periods

Plot No.	Grain								Stover or straw								Plot No.
	1894-1898		1899-1903		1904-1908		1909-1913		1894-1898		1899-1903		1904-1908		1909-1913		
	Yield Bus.	Increase Bus.	Yield Bus.	Increase Bus.	Yield Bus.	Increase Bus.	Yield Bus.	Increase Bus.	Yield Lbs.	Increase Lbs.	Yield Lbs.	Increase Lbs.	Yield Lbs.	Increase Lbs.	Yield Lbs.	Increase Lbs.	
Corn																	
1	29.19	.....	21.85	.....	17.09	.....	15.82	.....	1,449	.....	1,234	.....	1,546	.....	1,490	.....	1
2	44.61	15.53	47.21	27.03	38.50	24.08	36.41	23.75	2,076	630	2,202	1,013	2,520	1,394	2,496	1,096	2
3	38.86	9.88	39.09	20.59	28.00	16.25	26.83	17.33	1,770	330	1,820	671	2,138	848	2,016	706	3
4	28.86	.....	16.81	.....	9.09	.....	6.34	.....	1,436	.....	1,106	.....	1,162	.....	1,220	.....	4
5	36.44	8.68	29.21	12.75	23.77	14.75	18.92	12.38	1,670	278	1,588	497	1,958	773	1,830	615	5
6	43.13	16.49	40.11	24.01	34.62	25.65	30.22	23.48	1,938	590	1,924	851	2,404	1,195	2,296	1,087	6
7	25 53	.....	15.74	.....	8.86	.....	6.95	.....	1,304	.....	1,060	.....	1,232	.....	1,204	.....	7
8	44.43	20.26	52.55	37.85	44.55	36.41	45.82	39.64	2,008	749	2,376	1,358	2,568	1,415	2,698	1,572	8
9	42.76	19.96	50.13	36.45	41.73	34.34	41.97	36.56	1,870	655	2,232	1,256	2,458	1,383	2,512	1,464	9
10	21.44	.....	12.65	.....	6.64	.....	4.63	.....	1,170	.....	934	.....	996	.....	970	.....	10
	26.26	.....	16.76	.....	10.43	.....	8.44	.....	1,339	.....	1,083	.....	1,231	.....	1,221	.....	
Oats																	
1	26.87	.....	16.75	.....	20.40	.....	15.54	.....	892	.....	578	.....	855	.....	815	.....	1
2	42.22	14.75	40.11	22.39	45.46	24.59	34.47	18.06	1,697	749	1,701	1,083	2,136	1,279	2,204	1,356	2
3	38.75	10.67	36.47	17.78	40.79	19.46	30 89	13.60	1,470	467	1,463	806	1,890	1,037	1,710	628	3
4	28.67	.....	19.66	.....	21.80	.....	18.15	.....	1,059	.....	697	.....	855	.....	915	.....	4
5	30.83	2.40	28.51	8.13	35.03	12 98	26.09	7.72	1,021	—55	1,030	283	1,565	670	1,447	482	5
6	34.81	6.63	36.76	15.67	44.10	21.83	33.84	15.25	1,265	173	1,516	720	2,232	1,297	2,212	1,198	6
7	27.94	.....	21.82	.....	22.55	.....	18.81	.....	1,110	.....	846	.....	974	.....	1,064	.....	7
8	48.75	20.37	48.87	26.51	47.89	25.17	40.70	21.68	2,086	971	2,342	1,493	2,675	1,712	2,816	1,767	8
9	46.94	18.10	47.36	24.46	45.61	22.80	38.89	19.65	1,982	862	2,131	1,478	2,548	1,601	2,669	1,625	9
10	29.28	.....	23.43	.....	22.98	.....	19.45	.....	1,125	.....	856	.....	936	.....	1,019	.....	10
	28.19	.....	20.41	.....	21.93	.....	18.14	.....	1,046	.....	744	.....	905	.....	953	.....	
Wheat																	
1	10.56	.....	7.86	.....	5.95	.....	5.10	.....	1,334	.....	926	.....	1,038	.....	896	.....	1
2	19.78	9.32	21.90	13.73	17.41	11.21	17.28	11.82	2,205	967	2,420	1,489	2,701	1,684	2,559	1,680	2
3	16.33	5.97	16.90	8.42	13.31	6.87	14.80	8.99	1,720	579	1,644	709	2,158	1,163	2,039	1,178	3
4	10.26	.....	8.78	.....	6.68	.....	6.15	.....	1,044	.....	940	.....	973	.....	845	.....	4
5	13.28	3.13	14.26	5.28	12.23	5.74	14.09	7.99	1,475	430	1,498	550	1,973	982	1,913	1,060	5
6	15.77	5.72	18.46	9.28	17.48	11.18	18.75	12.72	1,743	698	2,014	1,057	2,670	1,663	2,542	1,680	6
7	9.95	.....	9.38	.....	6.11	.....	5.96	.....	1,045	.....	965	.....	1,025	.....	871	.....	7
8	20.69	10.87	25.26	16.47	20.88	14.80	22.04	16.60	2,510	1,463	2,724	1,810	3,208	2,239	3,191	2,394	8
9	19.01	9.33	22.45	14.25	19.12	13.10	20.06	15.15	2,159	1,110	2,181	1,323	2,846	1,933	2,641	1,919	9
10	9.55	.....	7.62	.....	6.00	.....	4.38	.....	1,051	.....	805	.....	858	.....	648	.....	10
	10.08	.....	8.41	.....	6.19	.....	5.40	.....	1,119	.....	909	.....	973	.....	765	.....	

II: THE 5-YEAR ROTATION

In this experiment corn, oats, wheat, clover and timothy are grown in succession on five tracts of land, sections A, B, C, D and E, containing 30 one-tenth acre plots each. Sections A and B of this test lie in range VIII, south of the areas devoted to continuous cropping, while sections C, D and E occupy Range IX, near the east side of the farm.

The land was underdrained in 1893 and corn was grown that season on Section C. The planting was delayed by the draining and the season proved unfavorable, so that the results of that season's work have not been included in the average. In 1894 wheat was harvested on section A, oats on section C and corn on section D. The clover and timothy followed the wheat on section A in 1895 and 1896, and the rotation has since been regularly followed.

Beginning with 1900, lime has been applied to the west half of each plot in this rotation, fertilized and unfertilized alike, while the land was being prepared for corn, the lime being applied at the rate of one ton per acre of ground quicklime in 1900, 1901, 1902 and 1903, applied in the spring after plowing, and in the fall of 1903 for the crop of 1904. In 1905 the liming was changed to the east half, a ton of quicklime being used that spring, but in 1906 and 1907 ground limestone was used, at the rate of two tons per acre. No lime was applied in 1908, but since then it has been applied to the west half as at the beginning, except that ground limestone has been used instead of quicklime. The table gives the average yield for the entire plot in each case, averaging the limed and unlimed halves.

In 1895 and 1896, and again in 1899, 1900 and 1901, the wheat in this test was injured by Hessian fly, the yield on the unfertilized land falling to a small fraction over one bushel per acre in 1896 and 1900. The wheat was again injured by Hessian fly in 1911, and also by joint worm. In 1912 these pests again prevailed, and in addition the winter conditions were such as to cause a partial to complete destruction of the wheat crop over the major portion of the State, the level lands of western Ohio suffering the most severely. The corn in this experiment was severely injured by white grubs in 1910 and 1912, the injury in 1912 being so great that no comparisons could be made.

The clover seeding failed to catch in 1904 and soybeans were grown instead and harvested as hay, the timothy crop of the following year being replaced by German millet. The timothy failed in 1909, as did the millet sown in its place so that no crop of either was harvested that year.

Diagram II shows the arrangement of plots and plan of fertilizing one of the sections in this experiment, the five sections being arranged and treated exactly alike. Tables III, V, VII and IX give the yields and increases per acre for 1913 and the averages for the entire period for corn, oats, wheat, clover and timothy, respectively. Tables, IV, VI, VIII and X give the average yields and increases by 5-year periods.

DIAGRAM II: PLAN OF FERTILIZING IN 5-YEAR ROTATION

Plots one-tenth acre—Fertilizing materials in pounds per acre

Plot No.	On corn			On oats			On wheat			
	Acid phosphate	Muriate of potash	Nitrate of soda	Acid phosphate	Muriate of potash	Nitrate of soda	Acid phosphate	Muriate of potash	Dried blood	Nitrate of soda
1	....	....	....	.. .	....	....	....	....	....	....
2	80	....	....	80	....	....	160	....	....	....
3	....	80	....	....	80	....	....	100	....	....
4	....	....	....	....	....	....	....	....	....	....
5	....	....	160	....	....	160	....	....	50	120
6	80	....	160	80	....	160	160	....	50	120
7	....	....	....	....	....	....	....	....	....	....
8	80	80	....	80	80	....	160	100	....	....
9	....	80	160	....	80	160	....	100	50	120
10	....	....	....	....	....	....	....	....	....	....
11	80	80	160	80	80	160	160	100	50	120
12	80	80	240	80	80	240	160	100	50	200
13	....	....	....	....	....	....	....	....	....	....
14	80	80	160	....	....	....	160	100	50	120
15	....	....	....	....	....	....	160	100	50	120
16	....	....	....	....	....	....	....	....	....	....
17	160	80	80	160	80	80	160	100	25	60
18	Barnyard manure, 8 tons on corn and wheat									
19	....	....	....	....	....	....	...	....	....	. ..
20	Barnyard manure, 4 tons on corn and wheat									
21	Same elements as 17, but nitrogen in oilmeal									
22	....	....	....	....	....	....	....	....	....	....
23	Same elements as 17, but nitrogen in dried blood									
24	Same elements as 17, but nitrogen in sulphate ammonia									
25	....	....	....	....	....	....	....	....	....	....
26	Same elements as 11, but phosphorus in bonemeal									
27	Same elements as 17, but nitrogen in nitrate of lime									
28	.. .	....	....	....	....	....	....	....	....	....
29	Same elements as 11, but phosphorus in basic slag									
30	Same elements as 17, but nitrogen in tankage									

Note: During the first 5 years the quantities of elements on Plots 17, 21, 23 and 24 were the same as on Plot 11, and those of nitrogen and potassium on Plot 30 were smaller. Previous to 1910 Plot 27 received the same quantities of elements as Plot 11.

TABLE III: Yield and increase per acre of CORN grown in 5-year rotation: 1913 and 20 years, 1894-1913

Plot	Fertilizing materials	1913				20 years, 1894-1913				Plot
		Yield		Increase		Yield		Increase		
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	
No.	Pounds per acre	Bus.	Lbs.	Bus.	Lbs.	Bus.	Lbs.	Bus.	Lbs.	No.
1	None	14.00	1,230	.....	...	29.84	1,650	.....	...	1
2	Acid phosphate, 80	26.36	1,510	13.09	300	37.23	1,852	7.78	214	2
3	Muriate potash, 80	12.96	1,350	.41	160	33.46	1,899	4.39	272	3
4	None	11.82	1,170	.....	...	28.68	1,617	.....	...	4
5	Nitrate soda, 160	16.21	1,370	5.18	177	33.69	1,798	4.71	180	5
6	Acid phosphate, 80; nitrate soda, 160	26.79	1,570	12.54	353	43.67	1,971	14.39	352	6
7	None	15.46	1,240	.....	...	29.58	1,620	.....	...	7
8	Acid phophate, 80; muriate potash, 80	33.11	1,640	17.70	390	43.52	2,149	14.40	545	8
9	Muriate potash, 80; nitrate soda, 160	20.57	1,530	5.20	270	35.35	1,919	6.68	332	9
10	None	15.32	1,270	.....	...	28.21	1,570	.....	...	10
11	Acid phosphate, 80; muriate potash, 80; nitrate soda, 160	37.61	1,910	22.49	650	46.95	2,264	18.66	686	11
12	" " 80; " " 80, " " 240	33.43	1,770	18.52	520	47.13	2,271	18.77	684	12
13	None	14.71	1,240	.....	...	28.41	1,594	.....	...	13
14	Acid phosphate, 80; muriate potash, 80; nitrate soda, 160	31.96	1,700	18.00	500	43.79	2,163	16.07	571	14
15	Fertilized on wheat only	18.14	1,330	4.93	170	33.34	1,813	7.44	256	15
16	None	12.46	1,120	.....	...	26.32	1,587	.....	...	16
17	Acid phosphate, 160; muriate potash, 80; nitrate soda, 80	42.50	1,750	29.87	617	46.49	2,233	19.54	647	17
18	Barnyard manure, 8 tons each on corn and wheat	50.54	2,080	37.75	933	51.81	2,440	23.78	831	18
19	None	12.96	1,160	.....	...	29.62	1,686	.....	...	19
20	Barnyard manure, 4 tons each on corn and wheat	31.50	1,620	17.98	453	43.07	2,148	14.31	479	20
21	Same elements as 17, but nitrogen in oilmeal	39.64	1,860	25.56	687	46.10	2,234	18.20	582	21
22	None	14.64	1,180	.....	...	27.04	1,636	.....	...	22
23	Same elements as 17, but nitrogen in dried blood	37.82	1,780	22.44	577	46.12	2,238	18.11	575	23
24	Same elements as 17, but nitrogen in sulphate ammonia	39.89	1,780	23.77	553	46.66	2,262	17.68	571	24
25	None	16.86	1,250	.....	...	29.94	1,717	.....	...	25
26	Same elements as 11, but phosphorus in bonemeal	26.25	1,590	8.58	320	44.46	2,266	13.87	530	26
27	Same elements as 17, but nitrogen in nitrate of lime	37.36	1,720	18.88	430	46.79	2,282	15.55	527	27
28	None	19.29	1,310	.....	...	31.88	1,775	.....	...	28
29	Same elements as 11, but phosphorus in basic slag	33.00	1,650	13.71	340	47.10	2,362	15.22	587	29
30	Same elements as 17, but nitrogen in tankage	39.96	1,670	20.67	360	47.31	2,231	15.43	456	30
	Average unfertilized yield	14.75	1,220	.....	...	28.95	1,645	.....	...	
	Average yield and increase from complete fertilizer	34.80	1,709	18.95	477	45.19	2,218	16.21	556	

Note: During the first 5 years the quantities of elements on Plots 17, 21, 23 and 24 were the same as on Plot 11, and those of nitrogen and potassium in Plot 30 were smaller. Previous to 1910 Plot 27 received the same quantities of elements as Plot 11.

TABLE IV: Yield and increase per acre of CORN by 5-year perlods. Bushels per acre

Plot	Fertilizing materials	1894-1898		1899-1903		1904-1908		1909-1913		Plot
		Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
No.	Pounds per acre	Bus.	Bns.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	No.
1	None	31.38	.....	32.92	.....	30.35	.....	22.76	.....	1
2	Acid phosphate, 80	36.02	3.96	41.90	9.74	40.33	9.78	29.00	7.59	2
3	Muriate potash, 80	34.93	2.69	36.14	4.74	37.55	6.79	23.17	3.11	3
4	None	32.43	.....	30.64	.....	30.95	.....	18.69	.....	4
5	Nitrate soda, 160	35.38	2.33	36.24	5.75	37.37	6.01	23.77	4.77	5
6	Acid phosphate, 80; nitrate soda, 160	43.32	9.65	47.61	17.26	46.95	15.17	35.09	15.77	6
7	None	34.29	.....	30.20	.....	32.17	.....	19.62	.....	7
8	Acid phosphate, 80; muriate potash, 80	40.11	7.21	44.49	14.17	50.69	19.42	37.60	17.41	8
9	Muriate potash, 80; nitrate soda, 160	33.00	1.48	36.62	6.19	40.47	10.10	30.28	9.52	9
10	None	30.13	.....	30.55	.....	29.47	.....	21.33	.....	10
11	Acid phosphate, 80; muriate potash, 80; nitrate soda, 160	41.28	10.72	49.90	19.45	54.13	24.04	41.37	20.90	11
12	" " 80; " " 80; " " 240	41.07	10.09	52.18	21.82	52.88	22.14	41.20	21.58	12
13	None	31.41	.....	30.26	.....	31.38	.....	18.76	.....	13
14	Acid phosphate, 80; muriate potash, 80; nitrate soda, 160[1]	40.96	10.27	47.81	18.33	48.85	18.37	35.98	17.61	14
15	Fertilized on wheat only	32.26	5.92	35.52	6.83	39.13	9.42	24.47	6.49	15
16	None	29.23	.....	27.91	.....	28.81	.....	17.59	.....	16
17	Acid phosphate, 160; muriate potash, 80; nitrate soda, 80[2]	35.78	6.59	49.54	20.48	53.91	23.87	44.10	25.88	17
18	Barnyard manare, 8 tons each on corn and wheat	40.73	10.04	49.52	19.32	59.75	28.48	55.83	37.24	18
19	None	33.12	.....	31.35	.....	32.49	.....	19.47	.....	19
20	Barnyard manure, 4 tons each on corn and wheat	38.91	7.10	43.08	12.82	50.31	18.74	39.21	19.65	20
21	Same elements as 17, but nitrogen in oilmeal	37.66	7.16	48.79	19.63	54.03	23.39	43.36	23.70	21
22	None	29.19	.....	28.06	.....	29.72	.....	19.75	.....	22
23	Same elements as 17, but nitrogen in dried blood	37.68	7.71	49.51	19.90	53.53	23.16	43.17	22.57	23
24	Same elements as 17, but nitrogen in sulphate ammonia	40.51	9.75	49.44	18.27	53.11	22.08	42.81	21.36	24
25	None	31.54	.....	32.72	.....	31.08	.....	22.30	.....	25
26	Same elements as 11, but phosphorus in bonemeal	39.14	6.22	50.31	17.30	51.28	19.01	35.26	12.72	26
27	Same elements as 17, but nitrogen in nitrate of lime	40.61	6.29	53.25	19.95	50.81	17.95	41.40	18.63	27
28	None	35.71	.....	33.58	.....	33.45	.....	23.01	.....	28
29	Same elements as 11, but phosphorus in basic slag	43.89	8.19	53.36	19.77	50.75	17.30	38.71	15.70	29
30	Same elements as 17, but nitrogen in tankage	41.73	6.02	46.51	12.93	54.87	21.42	43.35	20.34	30
	Average unfertilized yield	31.89	.....	30.82	.....	31.04	.....	20.31	.....	
	Average yield and increase from complete fertilizers	39.38	7.91	48.84	17.89	51.44	20.96	39.81	19.16	

[1]Fertilized on corn and wheat only. [2]During the first 5 years the quantities of elements were the same on Plots 17, 21, 23 and 24 as on Plot 11, and those of nitrogen and potassium on Plot 30 were smaller. Previous to 1910 Plot 27 received the same quantities of elements as Plot 11.

TABLE V: Yield and increase per acre of OATS grown in 5-year rotation: 1913, and 20 years, 1894-1914

Plot	Fertilizing materials	1913				20 years, 1894-1913				Plot
		Yield		Increase		Yield		Increase		
		Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	
No.	Pounds per acre	Bus.	Lbs.	Bus.	Lbs.	Bus.	Lbs.	Bus.	Lbs.	No.
1	None	11.56	520	.....	.....	31.24	1,313	.....	.....	1
2	Acid phosphate, 80	18.12	880	7.16	344	39.60	1,643	8.79	352	2
3	Muriate potash, 80	12.58	587	2.22	36	33.80	1,376	3.43	108	3
4	None	9.76	567	.....	.....	29.93	1,246	.....	.....	4
5	Nitrate soda, 160	12.65	705	2.50	157	34.04	1,392	4.01	148	5
6	Acid phosphate, 80; nitrate of soda, 160	25.47	895	14.92	366	45.53	1,924	15.41	681	6
7	None	10.94	510	.....	.....	30.22	1,242	.....	.....	7
8	Acid phosphate, 80; muriate potash, 80	24.21	1,245	14.24	791	42.60	1,819	12.52	615	8
9	Muriate potash, 80; nitrate soda, 160	11.32	437	2.31	39	36.05	1,608	6.12	383	9
10	None	8.04	342	.....	.....	29.79	1,217	.....	.....	10
11	Acid phosphate, 80; muriate potash, 80; nitrate soda, 160	24.22	1,065	15.16	672	48.80	2,222	18.93	981	11
12	" " 80; " " 80; " " 240	25.39	1,357	15.32	913	48.35	2,304	18.41	1,039	12
13	None	11.09	495	.....	.....	30.02	1,290	.....	.....	13
14	Fertilized on corn and wheat only	15.67	690	4.48	192	38.26	1,659	8.76	408	14
15	Fertilized on wheat only	14.06	670	2.76	168	31.68	1,311	3.64	160	15
16	None	11.40	505	.....	.....	28.44	1,172	.....	.....	16
17	Acid phosphate, 160; muriate potash, 80; nitrate soda, 80	30.47	1,505	18.68	936	47.92	2,296	19.02	1,091	17
18	Manured on corn and wheat	20.78	1,155	8.60	522	41.72	1,976	11.95	731	18
19	None	12.57	697	.....	.....	29.82	1,270	.....	.....	19
20	Manured on corn and wheat	17.42	782	4.12	22	36.73	1,629	7.23	374	20
21	Same elements as 17, but nitrogen in oilmeal	32.66	1,592	18.63	770	46.79	2,157	17.50	902	21
22	None	14.76	885	.....	.....	29.05	1,224	.....	.....	22
23	Same elements as 17, but nitrogen in dried blood	32.57	1,647	18.12	855	46.99	2,125	17.52	864	23
24	Same elements as 17, but nitrogen in sulphate ammonia	30.31	1,740	16.17	1,040	48.08	2,341	18.20	1,042	24
25	None	13.83	607	.....	.....	30.30	1,337	.....	.....	25
26	Same elements as 11, but phosphorus in bonemeal	22.87	1,170	9.64	600	45.70	2,044	14.99	718	26
27	Same elements as 17, but nitrogen in nitrate of lime	30.31	1,580	17.68	1,048	48.20	2,267	17.09	953	27
28	None	12.03	495	.....	.....	31.52	1,303	.....	.....	28
29	Same elements as 11, but phosphorus in basic slag	24.06	1,270	12.03	775	46.19	2,027	14.67	723	29
30	Same elements as 17, but nitrogen in tankage	32.97	1,755	20.94	1,260	44.15	1,976	12.63	673	30
	Average unfertilized yield	11.60	562	.....	.....	30.03	1,208	.....	.....	
	Average yield and increase from complete fertilizers	26.30	1,377	14.13	769	45.09	2,061	15.11	796	

Note: During the first 5 years the quantities of elements on Plots 17, 21, 23 and 24 were the same as on Plot 11, and those of nitrogen and potassium on Plot 30 were smaller. Previous to 1910 Plot 27 received the same quantities of elements as Plot 11, with nitrogen in nitrate of soda and phosphorus in dissolved boneblack.

TABLE VI: Yield and increase per acre of OATS by 5-year periods. Grain only.

Plot	Fertilizing materials	1894-1898		1899-1903		1904-1908		1909-1913		Plot
		Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
No.	Pounds per acre	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	No.
1	None	32.20	....	28.32	....	37.25	....	27.19	.....	1
2	Acid phosphate, 80	37.63	5.34	37.37	8.66	45.72	9.91	37.67	11.26	2
3	Muriate potash, 80	34.71	2.32	33.70	4.62	38.34	3.97	28.45	2.83	3
4	None	32.48	....	29.47	....	32.94	....	24.84	.....	4
5	Nitrate soda, 160	35.40	3.11	34.89	5.95	36.80	3.50	29.08	3.49	5
6	Acid phosphate 80; nitrate soda, 100	40.36	8.26	48.75	20.32	50.41	16.75	42.63	16.29	6
7	None	31.90	....	27.90	.....	34.02	.....	27.08	.....	7
8	Acid phosphate, 80; muriate potash, 80	38.26	6.87	40.92	12.72	48.89	14.34	42.34	16.16	8
9	Muriate potash, 80; nitrate soda, 160	33.36	2.46	35.75	7.26	39.60	4.53	35.50	10.22	9
10	None	30.39	..	28.78	.....	35.60	....	24.39	.....	10
11	Acid phosphate, 80; muriate potash, 80; nitrate soda, 100	43.61	12.92	52.48	23.74	53.49	18.35	45.61	20.72	11
12	" " 80; " " 80; " " 240	45.11	14.11	52.37	23.65	49.16	14.49	46.77	21.38	12
13	None	31.30	....	28.68	.....	34.22	.....	25.89	.....	13
14	Fertilized on corn and wheat only	36.79	6.19	37.18	9.23	42.69	8.95	36.37	10.68	14
15	Fertilized on wheat only	30.31	....	30.25	3.51	36.46	3.19	29.72	4.23	15
16	None	29.20	....	26.50	.....	32.79	.....	25.28	.....	16
17	Acid phosphate, 160; muriate potash, 80; nitrate soda, 80	38.03	8.57	49.19	22.21	54.97	21.68	49.52	23.62	17
18	Manured on corn and wheat	36.91	5.20	40.36	12.90	46.71	12.93	41.94	15.43	18
19	None	29.97	....	27.93	.....	34.27	.....	27.12	.....	19
20	Manured on corn and wheat	32.39	2.58	36.45	9.05	42.00	7.90	36.34	9.39	20
21	Same elements as 17, but nitrogen in oilmeal	37.43	7.78	50.64	24.51	52.87	18.93	46.97	20.20	21
22	None	29.50	....	26.33	.....	33.76	.....	26.60	.....	22
23	Same elements as 17, but nitrogen in dried blood	39.81	9.94	48.67	21.75	52.06	17.78	47.42	20.63	23
24	Same elements as 17, but nitrogen in sulphate ammonia	43.01	12.76	49.29	21.79	52.52	17.73	47.50	20.51	24
25	None	30.62	....	28.09	.....	35.30	.....	27.19	.....	25
26	Same elements as 11, but phosphoruse in bonemeal	43.04	12.11	47.11	18.00	49.98	14.82	42.65	15.02	26
27	Same elements as 11, but nitrogen in nitrate lime	43.54	12.29	51.59	21.48	52.91	17.89	44.76	16.68	27
28	None	31.56	....	31.12	.....	34.87	.....	28.53	.....	28
29	Same elements as 11, but phosphorus in basic slag	42.49	10.93	49.19	18.08	50.58	15.70	42.50	13.97	29
30	Same elements as 17, but nitrogen in tankage	35.47	3.91	45.78	14.65	49.83	14.96	45.51	16.98	30
	Average unfertilized yield	30.91	....	28.30	.....	34.50	.....	26.41	.....	
	Average yield and increase from complete fertilizers	39.89	10.14	46.98	18.57	49.79	15.37	43.78	17.05	

Note: During the first 5 years the quantities of elements on Plots 17, 21, 23 and 24 were the same as on Plot 11, and those of nitrogen and potassium on Plot 30 were smaller. Previous to 1910 Plot 27 received the same quantities of elements as Plot 11.

TABLE VII: Yield and increase per acre of WHEAT grown in 5-year rotation: 1913 and 20 years, 1894-1913

Plot	Fertilizing materials	1913				20 years, 1894-1913				Plot
		Yield		Increase		Yield		Increase		
		Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	
No.	Pounds per acre	Bus.	Lbs.	Bus.	Lbs.	Bus.	Lbs.	Bus.	Lbs.	No.
1	None	27.04	2,117	.....	.....	10.97	1,136	.....	.....	1
2	Acid phosphate, 160	26.66	2,760	1.89	760	18.55	1,861	7.58	734	2
3	Muriate potash, 100	20.00	2,020	—2.51	138	11.99	1,268	1.01	149	3
4	None	20.25	1,765	.....	.....	10.99	1,111	.....	.....	4
5	Dried blood, 50; nitrate soda, 120	22.62	2,777	2.22	975	12.83	1,435	1.87	321	5
6	Acid phosphate, 160; dried blood, 50; nitrate soda, 120	34.45	3,857	13.90	2,017	24.10	2,495	13.17	1,376	6
7	None	20.70	1,877	.....	.....	10.89	1,122	.....	.....	7
8	Acid phosphate, 160; muriate potash, 100	25.17	2,830	3.91	986	19.69	1,908	8.76	800	8
9	Muriate potash, 100; dried blood, 50; nitrate soda, 120	24.50	2,250	2.69	440	13.63	1,439	2.67	345	9
10	None	22.37	1,777	.....	.....	10.99	1,079	.....	.....	10
11	Acid phos., 160; mur. potash, 100; dried blood, 50; nit. soda, 120	39.46	4,732	17.45	3,013	26.88	2,888	15.93	1,806	11
12	Acid phos., 160; mur. potash, 100; dried blood, 50; nit. soda, 200	40.75	4,695	19.10	3,034	27.54	2,957	16.63	1,870	12
13	None	21.29	1,602	.....	.....	10.88	1,090	.....	.....	13
14	Acid phos., 160; mur. potash, 100; dried blood, 50; nit. soda, 120.	36.00	4,000	15.92	2,345	24.92	2,633	14.44	1,587	14
15	Acid phos., 160; mur. potash, 100; dried blood, 50; nit. soda, 120.	33.08	3,535	14.20	1,828	23.80	2,472	13.72	1,471	15
16	None	17.67	1,760	.....	.....	9.67	958	.....	.....	16
17	Acid phos., 160; mur. potash, 100; dried blood, 25; nit. soda, 60.	28.00	3,280	10.69	1,612	22.46	2,305	12.51	1,308	17
18	Barnyard manure, 8 tons	30.25	3,505	13.31	1,928	22.08	2,403	11.85	1,368	18
19	None	16.58	1,485	.....	.....	10.51	1,073	.....	.....	19
20	Barnyard manure, 4 tons	26.54	2,667	9.67	1,095	18.15	1,917	7.76	863	20
21	Same elements as 17, but nitrogen in oilmeal	27.58	3,045	10.42	1,385	23.29	2,430	13.02	1,394	21
22	None	17.45	1,747	.....	.....	10.15	1,017	.....	.....	22
23	Same elements as 17, but nitrogen in dried blood	27.66	3,145	9.62	1,384	22.24	2,250	11.79	1,189	23
24	Same elements as 17, but nitrogen in sulphate ammonia	29.71	3,417	11.09	1,643	22.89	2,336	12.14	1,231	24
25	None	19.21	1,787	.....	.....	11.04	1,149	.....	.....	25
26	Same elements as 11, but phosphorus in bonemeal	32.96	3,562	13.96	1,749	23.40	2,428	12.44	1,308	26
27	Same elements as 17, but nitrogen in nitrate of lime	31.04	3,757	12.25	1,918	25.63	2,653	14.74	1,563	27
28	None	18.58	1,865	.....	.....	10.80	1,062	.....	.....	28
29	Same elements as 11, but phosphorus in basic slag	32.12	3,072	13.54	1,207	24.33	2,531	13.53	1,469	29
30	Same elements as 17, but nitrogen in tankage	25.62	2,922	7.04	1,057	21.94	2,181	11.13	1,118	30
	Average unfertilized yield	20.12	1,778	.....	.....	10.70	1,082	.....	.....	
	Average yield and increase from complete fertilizer	32.00	3,597	12.94	1,848	24.11	2,505	13.50	1,443	

Note: Plot 14 is fertilized on corn and wheat only, and Plot 15 on wheat only. During the first 5 years the quantities of elements on Plots 17, 21, 23 and 24 were the same as on Plot 11, and those of nitrogen and potassium on Plot 30 were smaller. Previous to 1910 Plot 27 received the same quantities of elements as Plot 11.

TABLE VIII: Yield and increase per acre of WHEAT by 5-year periods, grain only

Plot	Fertilizing materials*	1894-1898		1899-1903		1904-1908		1909-1913		Plot
		Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
No.	Pounds per acre	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	No.
1	None	8.79	....	9.03	.....	13.43	.....	12.62	.....	1
2	Acid phosphate, 160	12.35	3.14	18.67	9.81	24.13	10.54	19.06	6.81	2
3	Muriate potash, 100	11.26	1.64	9.54	.86	15.11	1.37	12.04	.16	3
4	None	10.03	....	8.50	.....	13.90	.....	11.51	.....	4
5	Dried blood, 50; nitrate soda, 120	11.57	1.54	10.58	2.10	16.16	2.23	13.02	1.63	5
6	Acid phosphate, 160; dried blood, 50; nitrate soda, 120	16.84	6.81	24.46	16.00	30.87	16.92	24.21	12.94	6
7	None	10.02	....	8.45	.....	13.97	.....	11.15	.....	7
8	Acid phosphate, 160; muriate potash, 100	15.20	5.22	19.78	11.31	23.96	10.06	19.81	8.45	8
9	Muriate potash, 100; dried blood, 50; nitrate soda, 120	12.09	2.15	11.12	2.61	17.31	3.48	14.01	2.45	9
10	None	9.89	....	8.53	.....	13.76	.....	11.77	.....	10
11	Acid phosphate, 160; muriate potash, 100; dried blood, 50; nitrate soda, 120	20.53	10.73	27.47	18.82	33.10	19.32	26.43	14.86	11
12	Acid phosphate, 160; muriate potash, 100; dried blood, 50; nitrate soda, 200	20.95	11.23	29.37	20.61	33.58	19.77	26.27	14.90	12
13	None	9.63	....	8.88	.....	13.84	.....	11.18	.....	13
14	Acid phosphate, 160; muriate potash, 100; dried blood, 50; nitrate soda, 120	18.11	8.92	25.55	17.10	32.10	18.65	23.91	13.07	14
15	Acid phosphate, 160; muriate potash, 100; dried blood, 50; nitrate soda, 120	16.77	8.04	24.80	16.80	30.46	17.39	23.18	12.66	15
16	None	8.28	....	7.57	.....	12.68	.....	10.17	.....	16
17	Acid phosphate, 160; muriate potash, 100; dried blood, 25; nitrate soda, 60	13.84	5.55	23.20	15.39	29.28	16.11	23.51	12.97	17
18	Barnyard manure, 8 tons	12.65	4.35	19.02	10.97	29.97	16.29	26.67	15.78	18
19	None	8.31	....	8.28	.....	14.18	.....	11.26	.....	19
20	Barnyard manure, 4 tons	11.48	3.25	14.67	6.41	24.47	10.52	21.99	10.87	20
21	Same elements as 17, but nitrogen in oilmeal	18.35	10.20	23.88	15.66	27.95	14.24	22.98	11.99	21
22	None	8.07	....	8.20	.....	13.49	.....	10.86	.....	22
23	Same elements as 17, but nitrogen in dried blood	16.78	8.14	23.28	14.71	26.47	12.95	22.44	11.38	23
24	Same elements as 17, but nitrogen in sulphate ammonia	17.85	8.64	22.97	14.02	27.48	13.93	23.25	11.98	24
25	None	9.78	....	9.32	.....	13.60	.....	11.48	.....	25
26	Same elements as 11, but phosphorus in bonemeal	18.17	8.33	24.18	15.07	28.12	14.66	23.13	11.70	26
27	Same elements as 17, but nitrogen in nitrate of lime	18.86	8.94	28.72	19.81	31.53	18.20	23.41	12.02	28
28	None	9.98	....	8.70	.....	13.20	.....	11.34	.....	27
29	Same elements as 11, but phosphorus in basic slag	18.71	8.73	26.58	17.88	28.54	15.34	23.51	12.17	29
30	Same elements as 17, but nitrogen in tankage	14.66	4.68	23.90	15.20	27.35	14.15	21.84	10.50	30
	Average unfertilized yield	9.28	....	8.55	.....	13.66	.....	11.33	.....	
	Average yield and increase from complete fertilizers	17.80	8.51	25.34	16.76	29.66	16.23	23.65	12.52	

Note: Plot 14 is fertilized on corn and wheat only, and Plot 15 on wheat only. During the first 5 years the quantities of elements on Plots 17, 21, 23 and 24 were the same as on Plot 11, and those of nitrogen and potassium on Plot 30 were smaller. Previous to 1910 Plot 27 received the same quantities of elements as Plot 11, with nitrogen in nitrate of soda and phosphorus in dissolved boneblack.

The wheat crop, like the oats, shows a large increase in the unfertilized yield during the third period as compared with either of those preceding. This is due in part to better seasonal conditions, in part to the use of lime during the third period, but chiefly to the deliverance from insect depredations, there having been severe attacks of Hessian fly in 1895 and 1896 and again in 1899 to 1901. While, therefore, the total yield is much larger on every plot during the third period than before, the average increase from the fertilizers is not any greater. The average for the fourth period was reduced by the crop failure of 1912, which was general over the state.

TABLE IX: Yield and increase per acre of CLOVER and TIMOTHY grown in 5-year rotation: 1913 and during the entire period of the experiment.

Plot	Total quantities of fertilizing materials applied to previous crops of the rotation. None on clover or timothy.	Clover				Timothy				Plot
		1913		19-year average		1913		18-year average		
		Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
No.	Pounds per acre	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	No.
1	None	1,084	...	1,935	...	2,035	...	2,825	...	1
2	Acid phosphate, 320	1,431	465	2,450	515	2,684	575	3,098	310	2
3	Muriate potash, 260	1,138	291	2,178	242	2,178	−6	2,877	126	3
4	None	729	...	1,936	...	2,258	...	2,714	...	4
5	Nitrate soda, 440; dried blood, 50	1,058	344	2,269	356	2,213	35	3,084	407	5
6	Acid phosphate, 320; nitrate soda, 440; dried blood, 50	1,662	963	3,051	1,160	2,551	453	3,440	801	6
7	None	684	..	1,868	.....	2,018	...	2,603	...	7
8	Acid phosphate, 320; muriate potash, 260	1,280	676	2,812	971	2,800	773	3,104	512	8
9	Muriate potash, 260; nitrate soda, 440; dried blood, 50	764	240	2,234	431	2,329	294	2,950	370	9
10	None	444	...	1,770	.....	2,044	...	2,569	...	10
11	Acid phos., 320; mur. potash, 260; nit. soda, 440; dried blood, 50	1,200	771	3,194	1,407	3,093	939	3,554	988	11
12	Acid phos., 320; mur. potash, 260; nit. soda, 680; dried blood, 50	1,440	1,025	3,304	1,500	3,582	1,319	3,491	927	12
13	None	400	.....	1,821	.....	2,373	.....	2,560	...	13
14	Acid phos., 240; mur. potash, 180; nit. soda, 280; dried blood, 50	916	483	2,809	1,042	2,400	101	3,155	629	14
15	Acid phos., 160; mur. potash, 100; nit. soda, 120; dried blood, 50	720	255	2,462	749	2,364	139	2,893	401	15
16	None	498	.....	1,657	.....	2,151	.....	2,459	...	16
17	Acid phos., 480; mur. potash, 260; nit. soda, 220; dried blood, 25	1,796	1,263	3,023	1,317	3,440	1,156	3,274	765	17
18	Yard manure, 16 tons	2,933	2,364	3,837	2,082	4,480	2,062	4,095	1,537	18
19	None	604	.....	1,803	...	2,551	.....	2,608	...	19
20	Yard manure, 8 tons	1,156	549	2,871	1,138	3,378	1,034	3,505	983	20
21	Same elements as 17, but nitrogen in oilmeal	1,280	670	2,800	1,137	3,458	1,322	3,144	708	21
22	None	613	...	1,593	.....	1,929	.....	2,351	...	22
23	Same elements as 17, but nitrogen in dried blood	1,582	975	2,756	1,077	2,995	956	3,112	650	23
24	Same elements as 17, but nitrogen in sulphate ammonia	1,671	1,069	2,888	1,123	3,031	883	3,085	512	24
25	None	596	...	1,852	.....	2,258	...	2,695	...	25
26	Same elements as 11, but phosphorus in bonemeal	1,796	1,197	3,352	1,486	3,227	1,073	3,640	903	26
27	Same elements as 17, but nitrogen in nitrate of lime	1,707	1,105	2,968	1,087	2,818	767	3,449	657	27
28	None	605	.....	1,896	.....	1,947	.....	2,847	...	28
29	Same elements as 11, but phosphorus in basic slag	1,867	1,262	3,194	1,298	3,360	1,413	3,808	961	29
30	Same elements as 17, but nitrogen in tankage	1,769	1,164	3,211	1,315	3,298	1,351	3,797	950	30
	Average unfertilized yield	626	.....	1,813	.. .	2,156	.....	2,622	...	
	Average yield and increase from complete fertilizers	1,479	937	2,997	1,211	3,089	952	3,367	754	

Note: During the first 5 years the quantities of elements on Plots 17, 21, 23 and 24 were the same as on Plot 11, and those of nitrogen and potassium on Plot 30 were smaller. Previous to 1910 Plot 27 received the same quantities of elements as Plot 11.

TABLE X: Yield and increase per acre of CLOVER and TIMOTHY hay by periods

Plot	Clover								Timothy								Plot
	5 yrs., 1895-1899		5 yrs., 1900-1904		5 yrs., 1905-1909		4 yrs., 1910-1913		5 yrs., 1896-1900		5 yrs., 1901-1905		5 yrs., 1906-1910		3 yrs., 1911-1913		
	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
No.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	No.
1	1,650	.....	1,759	.....	2,737	.....	1,466	.....	2,714	.....	2,844	.....	3,317	.....	2,320	.....	1
2	2,120	387	2,018	273	3,621	925	1,824	403	2,882	186	2,802	67	3,944	637	2,820	484	2
3	1,934	117	1,768	36	3,279	613	1,515	139	3,014	336	2,600	—28	3,384	87	2,435	82	3
4	1,900	.....	1,718	.....	2,631	.....	1,331	.....	2,660	.....	2,517	.....	3,286	.....	2,370	.....	4
5	1,984	100	2,130	489	3,085	481	1,746	386	2,842	213	2,894	449	3,951	689	2,649	284	5
6	2,798	930	2,397	834	4,155	1,578	2,640	1,251	3,116	517	3,156	786	4,448	1,211	3,108	750	6
7	1,852	.....	1,485	.....	2,550	.....	1,417	.....	2,568	.....	2,300	.....	3,213	.....	2,353	.....	7
8	2,574	690	1,909	420	4,142	1,683	2,351	1,009	2,850	337	2,740	441	3,984	740	2,957	618	8
9	2,258	342	1,857	365	2,908	541	1,737	471	2,682	225	2,801	501	3,649	373	2,714	389	9
10	1,948	.....	1,495	.....	2,275	.....	1,191	.....	2,402	.....	2,300	.....	3,307	.....	2,311	.....	10
11	2,952	989	2,613	1,165	4,379	2,040	2,597	1,381	3,246	819	3,311	960	4,609	1,382	3,066	788	11
12	3,076	1,097	2,663	1,264	4,707	2,304	2,726	1,483	2,942	491	3,361	959	4,578	1,432	3,173	928	12
13	1,992	.....	1,352	.....	2,467	.....	1,269	.....	2,476	.....	2,450	.....	3,064	.....	2,213	.....	13
14	2,858	944	2,201	886	3,795	1,412	2,122	858	3,082	623	2,966	609	3,960	908	2,521	299	14
15	2,400	564	1,797	524	3,387	1,087	2,046	786	2,846	405	2,626	362	3,626	588	2,441	210	15
16	1,758	.....	1,237	.....	2,215	.....	1,255	.....	2,424	.....	2,172	.....	3,025	.....	2,240	.....	16
17	2,536	745	2,221	927	4,351	2,084	2,775	1,464	2,898	445	2,748	549	4,466	1,371	3,182	849	17
18	3,075	1,237	2,870	1,518	5,345	3,027	3,887	2,520	3,520	1,037	3,430	1,204	5,463	2,297	4,335	1,907	18
19	1,856	.....	1,411	.....	2,370	.....	1,422	.....	2,512	.....	2,252	.....	3,237	.....	2,521	.....	19
20	2,556	761	2,200	855	3,906	1,664	2,614	1,236	3,082	655	2,908	747	4,764	1,610	3,526	1,085	20
21	2,526	793	1,910	631	3,997	1,882	2,536	1,142	2,790	447	2,662	593	4,171	1,099	3,170	811	21
22	1,672	.....	1,212	.....	1,987	.....	1,380	.....	2,258	.....	1,977	.....	2,988	.....	2,278	.....	22
23	2,518	779	1,894	610	3,769	1,638	2,649	1,216	2,824	467	2,593	534	4,142	1,013	3,081	663	23
24	2,486	679	1,946	590	4,255	1,980	2,624	1,139	2,784	327	2,604	463	3,935	667	3,253	697	24
25	1,874	.....	1,428	.....	2,420	.....	1 538	.....	2,556	.....	2,222	.....	3,408	.....	2,696	.....	25
26	2,686	842	2,746	1,250	4,871	2,408	2,893	1,374	3,358	709	3,200	913	4,857	1,383	3,221	567	26
27	2,424	610	2,343	778	4,344	1,837	2,555	1,055	3,268	525	3,005	653	4,584	1,044	2,977	364	27
28	1,784	.....	1,632	.....	2,550	.....	1 482	.....	2,836	.....	2,416	.....	3,605	.....	2,571	.....	28
29	2,512	728	2,737	1,105	4,316	1,795	3,064	1,582	3,686	850	3,378	962	4,797	1,192	3,407	836	29
30	2,460	676	2,366	733	4,739	2,188	3,084	1,602	3,538	702	3,232	816	4,866	1,260	3,745	1 174	30
*	1,829	.....	1,473	.....	2,420	.....	1,375	.....	2,541	.....	2,345	.....	3,245	.....	2,387	.....	
**	2,620	787	2,286	872	4,245	1,888	2,639	1,257	3,105	567	2,974	968	4,383	1,112	3,103	682	

*Average unfertilized yield.
**Average yield and increase from complete fertilizer.

TABLE XI. THE 5-YEAR ROTATION AT WOOSTER. Total fertilizing materials and their cost, and total and net value of increase produced for 5-year periods and for 20 years, all calculated for one rotation of 5 years.

Plot No.	Fertilizing materials in pounds per acre for each rotation	Cost of fertilizers for each rotation	Average value of total increase per acre for each rotation					Net gain or loss (—) from fertilizers for each rotation					Plot No.
			First 5-yrs.	Second 5-yrs.	Third 5-yrs.	Fourth 5-yrs.	20-yr. av. total	First 5-yrs.	Second 5-yrs.	Third 5-yrs.	Fourth 5-yrs.	20 yr. av. net	
2	Acid phosphate, 320	$ 2.60	$ 8.50	$17.37	$24.32	$16.96	$16.52	$ 5.90	$14.77	$21.72	$14.36	$13.92	2
3	Muriate potash, 260	6.50	5.19	4.67	9.17	3.81	5.73	—1.31	—1.83	2.67	—2.69	—.77	3
5	Nitrate soda, 440; dried blood, 50	14.40	4.70	10.47	9.30	7.74	8.37	—9.70	—4.00	—5.37	—6.66	—6.03	5
6	Acid phosphate, 320; nitrate soda, 440; dried blood, 50	17.00	19.09	35.27	39.75	32.44	31.34	2.09	18.27	22.75	15.44	14.34	6
5	Acid phosphate, 320; muriate potash, 260	9.10	14.40	24.37	33.51	27.73	24.69	5.30	15.27	24.41	18.63	15.59	8
9	Muriate potash, 260; nitrate soda, 440; dried blood, 50	20.90	5.85	11.35	13.23	14.04	11.07	—15.05	—9.55	—6.67	—6.86	—9.83	9
11	Acid phos., 320; mur. potash, 260; nit. soda, 440; dried blood, 50	23.50	26.39	42.43	49.96	39.42	39.28	2.90	18.93	26.46	15.92	15.78	11
12	" " 320; " " 260; " " 680; " " 50	30.70	26.16	45.53	48.24	41.05	39.98	—4.54	14.83	17.54	10.35	9.28	12
14	" " 240; " " 180; " " 280; " " 50	16.05	21.37	32.91	37.33	28.32	30.14	5.32	15.86	21.28	12.27	14.09	14
15	" " 160; " " 100; " " 120; " " 50	8.60	13.89	22.86	27.13	20.08	21.66	5.29	14.26	18.53	11.48	13.06	15
17	" " 480; " " 260; " " 220; " " 25	17.60	15.74	36.61	46.28	41.30	35.23	—1.86	19.01	28.68	23.70	17.63	17
18	Yard manure, 16 tons	?	19.82	34.24	55.94	54.45	40.40	?	?	?	?	?	18
20	Yard manure, 8 tons	?	13.02	21.28	35.36	30.09	24.54	?	?	?	?	?	20
21	Same elements as 17, but nitrogen in oilmeal	17.60	20.43	36.25	42.24	36.37	33.50	2.83	18.65	24.64	18.77	15.90	21
23	" " " 17, " " " dried blood	17.60	19.09	34.37	39.28	35.14	31.75	1.49	16.77	21.68	17.54	14.15	23
24	" " " 17, " " " sulphate ammonia	17.60	20.70	32.77	38.71	35.20	31.91	3.10	14.77	21.11	17.60	14.31	24
26	" " " 11, " phosphorus in bonemeal	23.50	20.89	36.17	42.55	29.68	32.37	—2.61	12.67	19.05	6.18	8.87	26
27	" " " 17, " nitrogen in nitrate of lime*	17.60	19.86	39.88	42.08	31.33	33.42	—3.64	16.38	18.58	7.83	9.92	27
29	" " " 11, " phosphorus in basic slag	23.50	21.91	39.32	39.04	32.84	33.42	—1.59	15.82	15.54	9.34	9.92	29
30	" " " 17, " nitrogen in tankage**	17.60	13.74	30.51	41.62	36.87	30.40	....	12.90	24.02	19.27	12.80	30

The nearest practicable approach to a common denominator for the various kinds of produce grown in this rotation is their market value, and in Table VI the results of the tests are arranged on this basis for four 5-year periods and for the entire 20 years, corn being rated at 40 cents per bushel, oats at 30 cents, wheat at 80 cents, hay $8.00 per ton, stover at $3.00 and straw at $2.00; valuations much below present prices for the grains, but not far from the average values during the period of the test.

The fertilizing materials are valued at a fraction over $16.00 per ton for acid phosphate, 2½ cents per pound for muriate of potash and 3 cents per pound for nitrate of soda; and it is assumed that the cost per pound of the fertilizing elements will be practically the same in the other carriers used on Plots 21 to 30, inclusive.

The table shows that the effectiveness of the fertilizers and manure increased during the first three periods, the greatest relative increase being shown by the manure. Taking the second part of the table, giving the net gain after deducting the cost of the fertilizers, it will be seen that during the first period eight of the fertilizer applications failed to produce sufficient increase to cover their cost; during the second period three, during the third period two, during the fourth period three. Every complete fertilizer has been used with a profit since the first period, but when either nitrate of soda or muriate of potash has been used unaccompanied by some carrier of phosphorus there has been a loss in each period (except from muriate of potash in the third period) and in the average of the 20 years.

Nevertheless, both nitrogen and potassium are essential to the highest net profit, as shown by comparing Plot 2, receiving phosphorus only, with Plot 6 receiving nitrogen, Plot 8 receiving potassium, and Plot 11 receiving both these elements in addition to phosphorus.

The results of the comparison of different carriers of nitrogen and phosphorus have been discussed in Circular No. 93.

*Since 1910; previously, same quantities of elements as on Plot 11, with nitrogen in nitrate of soda and phosphorus in dissolved boneblack.

**Since first period. Smaller application during first period.

III: THE POTATOES-WHEAT-CLOVER ROTATION

This experiment is located on the South Farm, southeast of the orchards, and contains three sections of 34 plots each. The south section (A) and about half of the middle section (B) had been in cultivation for an unknown period before the test began. The north part of section B and all of north section (C) were cleared from the forest for the purposes of this test. The old land was tile drained in 1893, and the work was begun by planting section A to potatoes in 1894. Wheat and clover followed in 1895 and 1896 and the rotation has been maintained regularly since.

The potato crops in this test have in some seasons been somewhat injured by blight, and in 1904 a dashing rain, coming just after the potatoes had been planted, washed much of the seed out of the ground. These difficulties have caused an irregular stand, and for this reason the attempt has been made to correct the yields on the basis of the average stand obtained on the unfertilized plots, but this method has not proved satisfactory and hence the actual yields are given in the table. In 1909 the potatoes were reduced to about one-third the average crop by a combined attack of white grub and Fusarium wilt, the latter causing the larger part of the injury. The crop was severely injured by wilt again in 1910 and considerably injured in 1911.

In 1895 and 1896 the wheat in this test was severely injured by Hessian fly, but it escaped the attack of I899 to 1901. In 1911 there was again some injury from fly and joint worm.

In 1909 the clover failed; attempts were made to grow crimson clover and soybeans in its stead, but there was failure in securing a stand of these crops also, so that it has been necessary to omit that season from the calculations. In 1905 continuous rains prevented harvesting the clover until very late, and caused the fertilized plots to lodge so that these plots weighed less than those not fertilized, though earlier in the season they had shown a distinctly larger growth. As there was no way by which the yields could be corrected and as it seemed desirable to include the crop in the general average because of its effect on the average unfertilized yield it has been so included, although the doing so slightly reduces the apparent average effect from the fertilizers.

Diagram III shows the arrangement of plots and plan of fertilizing one of the sections in this experiment, the three sections being arranged and treated alike. Tables, XII, XIII and XIV give the yield per acre for 1913 and for the 20 years, 1894-1914.

DIAGRAM III: PLAN OF FERTILIZING IN POTATOES-WHEAT-CLOVER ROTATION

PLOTS ONE-TENTH ACRE — Fertilizing materials in pounds per acre

Plot No.	On Potatoes			On Wheat			
	Acid phosphate	Muriate potash	Nitrate soda	Acid Phosphate	Muriate potash	Dried blood	Nitrate soda
1	....	....	....	....	....	....	....
2	160	....	....	160	....	....	....
3	....	100	....	....	100	....	....
4	....	....	....	....	....	....	....
5	....	....	80	....	....	50	120
6	160	....	80	160	....	50	120
7	....	....	....	....	....	....	....
8	160	100	....	160	100	....	....
9	....	100	80	....	100	50	120
10	....	....	....	....	....	....	....
11	160	100	80	160	100	50	120
12	160	100	160	160	100	50	200
13	....	....	....	....	....	....	....
14	320	200	160	160	100	50	120
15	480	300	320	....	....	....	....
16	....	....	....	....	....	....	....
17	....	....	....	Manure, 4 tons on wheat			
18	....	....	....	Manure, 8 tons on wheat			
19	....	....	....	....	....	....	...
20	160	100	80	160	100	25	60
21	Same elements as 20, but nitrogen in oilmeal						
22	....	....	....	...	....	....	....
23	Same elements as 20, but nitrogen in dried blood						
24	Same elements as 20, but nitrogen in sulphate ammonia						
25	....	....	....	....	....	....	....
26	Same elements as 11, but phosphorus in bonemeal						
27	Same elements as 20, but nitrogen in nitrate of lime*						
28	....	....	....	....	....	....	....
29	Same elements as 11, but phosphorus in basic slag						
30	Manure, 8 tons on potatoes			....	....	....	....
31	....	....	....	...	....	....	....
32	....	....	....	Manure, 16 tons on wheat			
33	Same elements as 20, but nitrogen in tankage						
34	....	....	....	....	....	....	....

*Since 1910; previously same elements as 11.

TABLE XII. Yield and increase of POTATOES grown in rotation with wheat and clover.

Plot No.	Fertilizing materials	1913		20 years 1894-1913		12 years 1894-1905		8 years 1906-1913		Plot No.
		Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
	Pounds per acre	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	
1	None	93.33	.....	146.28	.....	169.03	.....	112.14	.....	1
2	Acid phosphate, 160	98.00	1.12	158.60	10.95	190.29	18.40	111.06	—.14	2
3	Muriate potash, 100	137.17	36.95	162.23	13.22	180.78	6.01	134.40	24.03	3
4	None	103 67	.....	150.37	.....	177.63	.....	109.48	.....	4
5	Nitrate soda, 80	105.50	.86	156.26	8.82	179.57	6.55	121.30	12.21	5
6	Acid phosphate, 160; nitrate soda, 80	118.17	12.56	162.61	18.09	189.35	20.94	122.49	13 81	6
7	None	106.58	.....	141.59	.....	163.80	.....	108.28	.....	7
8	Acid phosphate, 160; muriate potash, 100	147.92	41.88	173.43	31.90	186.86	21.48	153 28	47.53	8
9	Muriate potash, 100; nitrate soda, 80	138.83	33.31	159.85	18.38	171.84	4.85	141.89	38.67	9
10	None	105.00	.....	141 40	.....	168.55	.....	100.68	.....	10
11	Acid phosphate, 160; muriate potash, 100; nitrate soda, 80	150.00	46.89	171.00	29.52	185.41	17.09	149.39	48 18	11
12	Acid phosphate, 160; muriate potash, 100; nitrate soda, 160	147.33	46.11	176.77	35.22	192.14	24.04	153.72	51.99	12
13	None	99.33	.....	141.62	.....	167.87	.....	102.25	.....	13
14	Acid phosphate, 320; muriate potash, 200; nitrate soda, 160	160.17	54.37	179.42	40.55	190.38	25.99	162.97	62.38	14
15	Acid phosphate, 480; muriate potash, 300; nitrate soda, 320	134.92	22.64	174.92	38.80	187.37	26.45	156.24	57.33	15
16	None	118.75	.....	133.36	.....	157.44	.....	97.24	.....	16
17	Yard manure, 4 tons, on wheat only	119.67	2.98	[1]146.17	[1]15.11	[2]172 05	[2]11.57	117.04	19.09	17
18	Yard manure, 8 tons, on wheat only	144.17	29.53	[1]154 76	[1]23.81	[2]176.39	[2]16.72	130.43	31.79	18
19	None	112.58	.....	132.31	.....	154.28	.....	99 35	.....	19
20	Acid phosphate, 160; muriate potash, 100; nitrate soda, 80	143.42	35.09	171.88	39 69	191.41	36.92	142.73	43 85	20
21	Same elements as 20, but nitrogen in oilmeal	144.83	40.75	165.73	33.67	181.89	27.39	141.50	43.08	21
22	None	99.53	.....	131.93	.....	154.60	.....	97.94	.....	22
23	Same elements as 20, but nitrogen in dried blood	144.25	45 22	162.93	31.33	176.20	21.99	143.04	45.35	23
24	Same elements as 20, but nitrogen in sulphate ammonia	146.50	48.27	169 17	37.90	183.95	29.14	148.49	51.06	24
25	None	97.42	.....	130.93	.....	153.42	.....	97.18	.....	25
26	Same elements as 11, but phosphorus in bonemeal	128.42	34.06	163.05	31.59	173.29	19.96	147.69	49.04	26
27	Same elements as 20, but nitrogen in nitrate of lime	131.83	40.53	167.96	35.97	180.96	27.72	148.46	48.34	27
28	None	88.25	.....	132.52	.....	153.14	.....	101.59	.....	28
29	Same elements as 11, but phosphorus in basic slag	119.50	32.69	167.80	33.66	173.66	19.27	159.01	55.26	29
30	Yard manure, 8 tons, on potatoes only	131.00	45.64	177.63	41.87	188.44	32.78	161.41	55.49	30
31	None	83.92	.....	137.38	.....	156.91	.....	108.07	.....	31
32	Yard manure, 16 tons, on wheat only	141.33	50.61	[1]184.19	[1]47.60	[2]192.26	[2]30.95	175.10	66.33	32
33	Same elements (since 1899) as 20, but nitrogen in tankage	126.08	28.55	[1]168.17	[1]32.83	[2]185.39	[2]26.71	149.79	39.72	33
34	None	104.33	.....	[1]134.18	.....	[2]156.07	.....	109.56	.....	34
	Average unfertilized yield	101.08	.....	137.67	.....	160.28	.....	103.75	.....	

[1]17 years, 1897-1913. [2]9 years, 1897-1905.

TABLE XIII: Yield and increase of WHEAT (grain) grown in rotation with potatoes and clover

Plot	Fertilizing materials	1913		19 yrs., 1895-1913		12 yrs., 1895-1906		7 yrs., 1907-1913		Plot
		Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
No.	Pounds per acre	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	Bus.	No.
1	None	27.21	.....	29.52	.....	29.48	.....	29.58	.....	1
2	Acid phosphate, 160	33.25	7.08	35.31	5.97	34.79	5.51	36.22	6.63	2
3	Muriate potash, 100	25.67	.55	30.79	1.53	31.32	2.25	29.89	.28	3
4	None	24.08	.....	29.14	.....	28.85	.....	29.62	.....	4
5	Dried blood, 50; nitrate soda, 120	29.75	3.42	29.70	.97	29.47	1.07	29.89	.79	5
6	Acid phosphate, 160; dried blood, 50; nitrate soda, 120	38.67	10.09	35.63	7.36	35.08	7.15	36.57	8.00	6
7	None	30 83	.....	27.68	.....	27.47	.....	28.05	.....	7
8	Acid phosphate, 160; muriate potash, 100	36.37	6.79	35.52	7.54	35 09	7.36	36 26	7.85	8
9	Muriate potash, 100; dried blood, 50; nitrate of soda, 120	33.42	5.09	33.07	4.79	33 58	5 60	32.18	3.41	9
10	None	27.08	.....	28 57	.....	28.24	.....	29.13	.....	10
11	Acid phos., 160; mur. potash, 100; dried blood, 50; nit. soda, 120	38.67	10.98	37.51	9.14	37.28	9.24	37.89	8 96	11
12	Acid phos., 160; mur. potash, 100; dried blood, 50; nit. soda, 200	40.83	12.52	37.36	9.20	37 16	9.31	37.74	9.01	12
13	None	28.92	.....	27 97	.....	27.64	.....	28.53	.....	13
14	Acid phos., 160; mur. potash, 100; dried blood, 50; nit. soda, 120	38.17	9.08	37.13	9.52	37.30	10.25	36.84	8.27	14
15	Fertilized on potatoes only	34.33	5.08	35 84	8.59	35.97	9.51	35.62	7.01	15
16	None	29.42	.....	26.89	.....	25.87	.....	28.65	.....	16
17	Yard manure, 4 tons	34.62	6.95	31.17	5.31	29.58	4 65	33.89	6.42	17
18	Yard manure, 8 tons	39.96	14.04	32.46	7.64	30.43	6.45	35.96	9.68	18
19	None	24.17	.....	23.80	.....	23.04	.....	25.10	.....	19
20	Acid phos., 160; mur. potash, 100; dried blood, 25; nit. soda, 60	38.46	14.51	33.92	10.29	32.12	9.13	37 00	12.26	20
21	Same elements as 20, but nitrogen in oilmeal	36.75	13.02	33.60	10.13	32.85	9.91	34.90	10.52	21
22	None	23.50	.....	23.31	.....	22.89	.....	24.02	.....	22
23	Same elements as 20, but nitrogen in dried blood	35.08	11.30	34.17	10.64	33.66	10.59	35.04	10.73	23
24	Same elements as 20, but nitrogen in sulphate ammonia	35.75	11.70	34 43	10.68	33 27	10.01	36.43	11.83	24
25	None	24.33	.....	23.98	.....	23.45	.....	24.89	.....	25
26	Same elements as 11, but phosphorus in bonemeal	36.83	10.39	34.36	10.24	34.28	10.77	34.50	9.34	26
27	Same elements as 20, but nitrogen in nitrate of lime*	41.33	12.77	35.80	11.54	35.49	11.91	36.34	10.90	27
28	None	30.67	.....	24.40	.....	23 64	.....	25.71	.....	28
29	Same elements as 11, but phosphorus in basic slag	43.21	14.79	36.37	12.14	36.07	12.50	36 89	11.52	29
30	Manured on potatoes	38.87	12.70	31.51	7.45	30.34	6.85	33.50	8.46	30
31	None	23.92	.....	23.89	.....	23.42	.....	24.70	.....	31
32	Yard manure, 16 tons	39.58	13.81	[1]37.02	[1]11.09	[2]37.52	[2]11.00	36.31	11.22	32
33	Same elements as 20, but nitrogen in tankage	38.92	11.31	[1]36.89	[1]11.03	[2]37.71	[2]11.57	35.73	10.26	33
34	None	29.46	.....	[1]25.80	.....	[2]25.75	.....	25.86	.....	34
	Average unfertilized yield	26 97	.....	26.08	.....	25.57	.....	26.97	.....	

*Since 1910. Previously same as 11, but phosphorus in dissolved bone black. [1] 17 years, 1897-1913. [2] 10 years, 1897-1906.

TABLE XIV. Yield and increase of CLOVER HAY in rotation with potatoes and wheat.

Plot	Total fertilizing materials applied to previous crops of rotation. None on clover.	1913		18 years 1896-1913		12 years 1896-1907		6 years 1908-1913		Plot
		Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase	
No.	Pounds per acre	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	No.
1	None	5,378	...	4,336	...	4,266	...	4,465	...	1
2	Acid phosphate, 320	5,000	—105	4,529	309	4,404	315	4,757	299	2
3	Muriate potash, 200	4,978	145	4,232	129	3,949	39	4,749	296	3
4	None	4,560	...	3,985	...	3,733	...	4,447	...	4
5	Nitrate soda, 200; dried blood, 50	4,213	173	4,267	339	3,927	205	4,889	586	5
6	Acid phosphate, 320; nitrate soda, 200; dried blood, 50	3,324	—196	4,373	502	3,997	285	5,059	899	6
7	None	3,000	...	3,812	...	3,702	...	4,015	...	7
8	Acid phosphate, 320; muriate potash, 200	3,360	323	4,101	342	3,915	235	4,441	539	8
9	Muriate potash, 200; nitrate soda, 200; dried blood, 50	3,769	695	4,301	597	4,100	441	4,670	880	9
10	None	3,111	...	3,652	...	3,638	...	3,678	...	10
11	Acid phos., 320; mur. potash, 200; nit. soda, 200; dried blood, 50	3,698	409	4,269	560	3,872	210	4,998	1,200	11
12	Acid phos., 320; mur. potash, 200; nit. soda, 360; dried blood, 50	3,769	303	4,458	690	4,075	390	5,158	1,239	12
13	None	3,644	...	3,826	...	3,709	...	4,039	...	13
14	Acid phos., 480; mur. potash, 300; nit. soda, 280; dried blood, 50	4,142	616	4,422	684	4,045	415	5,113	1,175	14
15	Acid phos., 480; mur. pot., 300; nit. soda, 320. On potatoes only	4,427	1,021	4,404	753	4,029	479	5,091	1,255	15
16	None	3,289	.....	3,564	...	3,470	...	3,735	.....	16
17	Yard manure, 4 tons, on wheat only	3,956	786	4,256	771	3,957	566	4,803	1,147	16
18	Yard manure, 8 tons, on wheat only	4,142	1,090	4,696	1,290	4,267	954	5,484	1,906	18
19	None	2,933	.....	3,327	...	3,234	...	3,498	.....	19
20	Acid phos., 320; mur. pot., 200; nit. soda, 140; dried blood, 25	3,262	513	4,149	844	3,904	649	4,599	1,202	20
21	Same elements as 20, but nitrogen in oilmeal	3,404	838	3,762	479	3,494	217	4,254	958	21
22	None	2,382	.....	3,262	...	3,299	...	3,194	.....	22
23	Same elements as 20, but nitrogen in dried blood	3,058	498	3,772	475	3,553	236	4,173	911	23
24	Same elements as 20, but nitrogen in sulphate ammonia	2,978	240	3,795	462	3,530	195	4,281	952	24
25	None	2,916	.....	3,368	...	3,353	...	3,396	.....	25
26	Same elements as 11, but phosphorus in bonemeal	3,556	776	4,204	797	3,852	481	4,849	1,376	26
27	Same elements as 20, but nitrogen in nitrate of lime[1]	3,156	513	4,023	577	3,676	286	4,660	1,111	27
28	None	2,507	.....	3,485	...	3,409	...	3,625	.....	28
29	Same elements as 11, but phosphorus in basic slag	4,089	1,247	4,541	1,040	4,122	743	5,308	1,586	29
30	Yard manure, 8 tons, on potatoes only	3,982	806	4,425	910	4,124	775	4,975	1,157	30
31	None	3,511	.....	3,529	...	3,274	...	3,915	.....	31
32	Yard manure, 16 tons, on wheat only[2]	5,387	1,980	[25]5,231	1,708	[24]4,616	1,296	6,153	2,326	32
33	Same elements (since 1899) as 20, but nitrogen in tankage[2]	3,804	500	[24]4,248	597	[23]3,686	317	5,090	1,018	33
34	None[2]	3,200	.....	[23]3,511	...	[22]3,796	...	3,650	.....	34
	Average unfertilized yield	3,369	.....	3,644	.....	3,647	...	3,805	.....	

[1]Since 1910. Previously same as 11, but phosphorus in dissolved boneblack.
[2]Plots 32, 33 and 34 were started in 1899.

TABLE XV: Three-year rotation of POTATOES, WHEAT AND CLOVER. Average value of increase for each rotation for 20 years and for periods of 12 years and 8 years

Plot No.	Fertilizing materials in pounds per acre for each rotation	Cost of fertilizer for each rotation	Average value of total increase per acre for each rotation			Net gain or loss (—) from fertilizers for each rotation			Plot No.
			20 years 1894-1913	12 years 1894-1905	8 years 1906-1913	20 years 1894-1913	12 years 1894-1905	8 years 1906-1913	
2	Acid phosphate, 320	$ 2.60	$10.99	$13 58	$ 7 11	$ 8.39	$10.98	$ 4.51	2
3	Muriate of potash, 200	5.00	7.18	4.58	11.05	2.18	—0.42	6.05	3
5	Nitrate of soda, 200; dried blood, 50	7.20	5.76	4.41	7.94	—1.44	—2.79	.74	5
6	Acid phosphate. 320; nitrate of soda, 200; dried blood, 50	9.80	15.87	15.95	16.32	6.07	6.15	6.52	6
8	Acid phosphate, 320:muriate of potash, 200	7.60	20.91	16.16	28.23	13.31	8.56	20.63	8
9	Muriate of potash, 200; nitrate of soda, 200: dried blood, 50	12.20	14.05	8.75	22.06	1.85	—3.45	9.86	9
11	Acid phos., 320; mur. of potash, 200; nit. of soda, 200; dried blood, 50	14.80	22.27	16.00	32.14	7.47	1.20	17.34	11
12	" " 320; " " 200; " " 360; " " 50	19.60	25.13	19.55	33.86	5.53	—0.05	14.26	12
14	" " 480; " " 300; " " 280; " " 56	21.00	27.52	21.28	37.10	6.52	.28	16.10	14
15	" " 480; " " 300; " " 320	21.00	26 26	21.05	34.26	5.26	.05	13.26	15
17	Manure, 4 tons, on wheat	?	13.91	11.08	18.00	.....	.....	.....	17
18	Manure, 8 tons, on wheat	?	21.56	16.31	29.05	.....	.....	.....	18
20	Acid phos., 320; mur. of potash, 200; nit. of soda, 140; dried blood, 25	12.40	28.51	25.58	33.38	16.11	13.18	20.98	20
21	Same elements as 20, but nitrogen in oilmeal	12.40	24.50	20.74	30.53	12.10	8.34	18.13	21
23	" " " 20, " " " dried blood	12.40	24.01	19.27	31.44	11.61	6.87	19.04	23
24	" " " 20, " " " sulphate of ammonia	12.40	26.62	21.44	34.88	14 22	9.04	22.48	24
26	" " " 11, " " " phosphorus in bonemeal	14.80	25.04	19.60	33.53	10.24	4.80	18.73	26
27	" " " 20, " " " nitrogen in nitrate of lime*	12 40	27.08	22.95	33.59	14 68	10.55	21.19	27
29	" " " 11, " " " phosphorus in basic slag	14.80	28.55	21.94	38.82	13.75	7.14	24.02	29
30	Manure, 8 tons, on potatoes	?	27.09	22.38	34.44	.....	.....	.....	30
32	Manure, 16 tons, on wheat	?	35.85	27.46	45.93	.....	.....	.....	32
33	Same elements as 20, but nitrogen and part of phosphorus in tankage	12.40	26.45	22.36	29.19	13.05	9.96	16.79	33

*Since 1910. Previously, same elements as 11, but phosphorus in dissolved bone black.

Table XV shows that there has been a marked increase in the rate of gain in this test when the fertilizer has carried potassium. Phosphorus alone in acid phosphate, shows a diminishing rate of increase (Plot 2) but when combined with potassium the increase, both total and net, is much greater than that from potassium alone (compare Plot 8 with Plot 3). Nitrogen seems to have had comparatively little effect in this rotation, yet the increase on Plot 11 has been abnormally small since the beginning of the experiment. (Compare Plots 11 with Plots 20 to 29, inclusive).

IV: BARNYARD MANURE TEST

COMPARISON OF YARD WITH FRESH MANURE. THE REINFORCEMENT OF MANURE

This experiment was begun in 1897 for the purpose of comparing manure which has lain for some months in an open barnyard with that taken directly from the stable to the field, and of studying the effect of treating the manure with several absorbent or reinforcing materials. In the earlier years of this investigation a lot of manure was taken from the open barnyard, where it had been accumulating during the winter, and divided into four parcels. With one parcel was mixed the finely ground phosphatic rock, known as floats, from which acid phosphate is made by mixing it with sulphuric acid; with another parcel acid phosphate was mixed; with a third, the crude potash salt, known as kainit, and with a fourth, land plaster or gypsum; the reinforcing materials being used at the uniform rate of 40 pounds per ton of manure. At the same time manure taken from box stalls, where it had accumulated under the feet of animals kept continuously in their stalls, was divided into similar parcels and treated with like quantities of the same materials.

After a few weeks the manure thus treated, together with two lots of untreated manure, one taken from the yard and one from the stable, was spread upon clover sod at the rate of eight tons per acre and plowed under for corn, the corn being followed by wheat and clover in a 3-year rotation. During the first three seasons soybeans were grown, because of clover failure, and were plowed under.

Because of the uncertainty as to the quantity of fresh manure required to produce a ton of yard manure under these conditions the plan was changed in 1903, and since then a sufficient quantity of fresh manure for the purpose of the experiment is weighed out of the stables in December or January and forked over carefully to secure a uniform product. The manure is then divided into five equal parcels, four of which are treated as above indicated, and the fifth is left untreated. Each parcel is then divided into two equal portions, one of which is immediately spread upon the plots receiving "stall manure," while the other is placed in a flat, compact pile in an open yard where it remains undisturbed until April, when it is spread on the "yard manure" plots, and the whole is plowed under at the rate of 8 tons per acre of the original manure.

Three tracts of land, A, B and C, are included in the test, each crop being grown every season. The arrangement of these tracts and the plan of fertilizing are shown in Diagram IV, and the results are given in Tables XVI, XVII and XVIII.

DIAGRAM IV: ARRANGEMENT OF PLOTS AND PLAN OF FERTILIZING IN EXPERIMENTS WITH MANURE

PLOTS ONE-SIXTEENTH ACRE

11	Nothing			Nothing	1
12	Yard manure and gypsum			Yard manure and floats	2
13	Stall manure and gypsum			Stall manure and floats	3
14	Nothing			Nothing	4
15	Yard manure, untreated			Yard manure and acid phos.	5
16	Stall manure, untreated			Stall manure and acid phos.	6
17	Nothing			Nothing	7
18	Chemical fertilizer			Yard manure and kainit	8
19	Chemical fertilizer			Stall manure and kainit	9
20	Nothing			Nothing	10
		SECTION A			
11	Nothing			Nothing	1
12	Yard manure and gypsum			Yard manure and floats	2
13	Stall manure and gypsum			Stall manure and floats	3
14	Nothing			Nothing	4
15	Yard manure, untreated			Yard manure and acid phos.	5
16	Stall manure, untreated			Stall manure and acid phos.	6
17	Nothing			Nothing	7
18	Chemical fertilizer			Yard manure and kainit	8
19	Chemical fertilizer			Stall manure aud kainit	9
20	Nothing			Nothing	10
		SECTION B			
11	Nothing			Nothing	1
12	Yard manure and gypsum			Yard manure and floats	2
13	Stall manure and gypsum			Stall manure and floats	3
14	Nothing			Nothing	4
15	Yard manure, untreated			Yard manure and acid phos.	5
16	Stall manure, untreated			Stall manure and acid phos.	6
17	Nothing			Nothing	7
18	Chemical fertilizer			Yard manure and kainit	8
19	Chemical fertilizer			Stall manure and kainit	9
20	Nothing			Nothing	10
		SECTION C			

NORTH

TABLE XVI: BARNYARD MANURE ON CROPS GROWN IN 3-YEAR ROTATION

Average yield per acre, 1913, and 17 years 1897-1913

Plot No.	Manure and treatment	1913				Clover Sec. B	17 years, 1897-1913				Hay 13 crops	Plot No.
		Corn, Sec. C		Wheat, Sec. A			Corn,* 16 crops		Wheat, 16 crops			
		Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Lbs.	Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Lbs.	
		Yield per acre										
1	None	64.00	2,592	20 27	2,176	3,129	40.77	2,381	12.50	1,515	3,122	1
2	Yard manure and floats	78.23	3,264	31.47	3,296	5,422	62.99	3,459	24.48	2,657	4,608	2
3	Stall manure and floats	80.86	3,424	32.60	3,500	5,458	66.38	3,664	25.85	2,835	5,054	3
4	None	40.23	2,160	18.20	1,836	3,467	32.12	2,072	10.96	1,294	2,422	4
5	Yard manure and acid phosphate	78.91	3,280	33.93	3,932	5,582	63.35	3,352	25.41	2,762	4,468	5
6	Stall manure and acid phosphate	83.83	3,520	33.40	4,012	5,346	67.16	3,577	25.97	2,911	5,096	6
7	None	39.26	2,320	19.20	2,112	3,396	31.39	2,017	9.94	1,240	2,440	7
8	Yard manure and kainit	69.94	3,120	27.87	3,272	4,284	56.92	3,276	20.73	2,386	3,745	8
9	Stall manure and kainit	73.54	3,264	30.33	3,268	4,462	61.82	3,530	22.38	2,638	4,488	9
10	None	39.71	2,176	20.07	2,060	3,698	33.78	2,054	10.50	1,294	2 612	10
11	None	62.17	2,560	23.47	2,672	3,698	40.10	2,444	13.64	1,711	3,370	11
12	Yard manure and gypsum	80.40	3,200	28.40	2,808	5,280	61.52	3,451	23.75	2,671	4,104	12
13	Stall manure and gypsum	73.77	3,088	29.33	2,848	4,942	62.38	3,541	23.50	2,618	4,116	13
14	None	38.80	2,160	19.07	1,976	5,236	32.43	2,082	10.66	1,265	2,485	14
15	Yard manure, untreated	68.74	2,864	26.00	2,600	4,444	54.15	2,978	19.68	2,219	3,523	15
16	Stall manure, untreated	70.80	2,916	27.93	3,044	5,458	60.20	3,330	21.15	2,417	4,250	16
17	None	48.29	2,400	17.73	1,784	4,758	38.10	2,365	10.96	1,355	2,891	17
18	Chemical fertilizer†	65.89	2,672	26.60	2,468	4,676	47.43	2,727	14.99	1,749	3,358	18
19	Chemical fertilizer‡	49.26	2,368	20.20	2,196	4,853	45.77	2,538	14.84	1,828	3,495	19
20	None	44.97	2,240	17.13	1,948	4,142	33.88	2,025	10.40	1,357	2,846	20
	Average unfertilized	47.18	2,326	19.39	2 070	3,690	35.19	2,179	11.11	1,357	2,773	

*Excluding crop of 1908 which was so injured by grub worms that no comparison is possible.
†Acid phosphate, 80 lbs.; muriate of potash, 80 lbs.; nitrate of soda, 160 lbs.
‡Acid phosphate, 80 lbs.; muriate of potash, 10 lbs.; tankage (7-30), 100 lbs.

TABLE XVII: Barnyard manure on crops grown in 3-year rotation. Average yield per acre by periods

Plot	Manure and treatment	First period—3 rotations					'Second period to 1913					Plot
		Corn 1897-1905		Wheat 1898-1906		Clover 1901-1907	Corn 1906-1913		Wheat 1907-1913		Clover 1908-1913	
		Grain	Stover	Grain	Straw		Grain	Stover	Grain	Straw		
No.		Bus.	Lbs.	Bus.	Lbs.	Lbs.	Bus.	Lbs.	Bus.	Lbs.	Lbs.	No.
1	None	40.10	2,284	11.18	1,346	2,363	41.63	2,505	14.19	1,751	4,007	1
2	Yard manure and floats	58.20	3,310	24.16	2,538	3,660	69.16	3,650	24.89	2,810	5,713	2
3	Stall manure and floats	61.97	3,614	25.76	2,716	4,293	72.05	3,728	25.96	2,989	5,942	3
4	None	34.84	2,108	9.83	1,111	1,771	28.62	2,025	12.42	1,529	3,182	4
5	Yard manure and acid phosphate	59.05	3,234	24.39	2,499	3,422	68.87	3,504	26.72	3,099	5,689	5
6	Stall manure and acid phosphate	62.28	3,522	25.26	2,689	4,212	73.45	3,648	26.88	3,197	6,126	6
7	None	34.28	2,060	8.78	1,025	1,728	27.67	1,961	11.47	1,518	3,272	7
8	Yard manure and kainit	54.23	3,154	20 26	2,221	2,922	60.38	3,433	21.34	2,599	4,705	8
9	Stall manure and kainit	58.80	3,466	22.36	2,553	3,711	65.71	3,614	22.40	2,746	5,393	9
10	None	35.83	2,120	9 96	1,153	2,016	31.15	1,968	11.19	1,475	3,306	10
11	None	39.63	2,440	12.18	1,498	2,685	40.71	2,449	15.51	1,985	4,170	11
12	Yard manure and gypsum	57.35	3,340	22.66	2,481	3,248	66 88	3,593	25.15	2,914	5,104	12
13	Stall manure and gypsum	59.40	3,556	22.39	2,470	3,172	66.22	3,522	24.92	2,809	5,217	13
14	None	35.71	2,098	8.83	990	1,669	28 21	2,062	13.03	1,619	3,437	14
15	Yard manure, untreated	51.43	2,936	17.20	1,921	2,409	57.64	3,031	22.87	2,603	4,821	15
16	Stall manure, untreated	57.13	3,362	18.87	2,102	3,069	64.14	3,290	24.08	2,822	5,628	16
17	None	38.77	2,381	9.31	1,121	1,982	37.23	2,345	13.06	1,656	3,952	17
18	Fertilizer*	44.74	2,688	11.82	1,404	2,699	50.90	2,777	19.07	2,193	4,126	18
19	Fertilizer**	45.19	2,501	13.56	1,565	2,842	46.52	2,585	16.49	2,168	4,258	19
20	None	36.72	2,106	9.61	1,212	2,216	30.23	1,920	11.41	1,543	3,580	20
	Average untreated	36.99	2,198	9.92	1,141	2,054	32.87	2,154	12.78	1,635	3,613	

* No manure; acid phosphate, 80 lbs.; muriate potash, 80 lbs.; nitrate soda, 160 lbs.
** No manure; acid phosphate, 80 lbs.; muriate potash, 10 lbs.; tankage, 100 lbs.

TABLE XVIII: Barnyard manure on crops grown in 3-year rotation. Average increase per acre and its value by periods

Plot	Manure and treatment	First period: 1896 to 1905-6-7—three rotations							Second period								Plot
		Average increase per acre					Net value of increase[1]		Average increase per acre					Net value of increase*			
		Corn 1897-1905		Wheat 1898-1906		Hay 1901-1907	Per acre	Per ton manure	Corn 1906-1913		Wheat 1907-1913		Hay 1908-1913	Per acre	Per ton manure		
		Grain	Stover	Grain	Straw				Grain	Stover	Grain	Straw					
No.		Bus.	Lbs.	Bus.	Lbs.	Lbs.	$	$	Bus.	Lbs.	Bus.	Lbs.	Lbs.	$	$		No.
2	Yard manure and floats	19.85	1,085	13.43	1,270	1,494	25.96	3.20	27.88	1,142	11.28	1,146	1,981	29.36	3.67		2
3	Stall manure and floats	25.38	1,448	15.48	1,526	2,325	33.93	4.24	34.21	1,350	12.95	1,393	2,485	35.82	4.48		3
5	Yard manure and acid phosphate	24.40	1,142	14.91	1,417	1,666	29.24	3.65	35.49	1,313	14.63	1,574	2,477	37.11	4.64		5
6	Stall manure and acid phosphate	27.81	1,446	16.13	1,634	2,470	35.44	4.43	39.77	1,457	17.44	1,910	2,884	43.25	5.41		6
8	Yard manure and kainit	19.43	1,074	11.08	1,153	1,098	21.55	2.69	27.61	1,286	9.97	1,096	1,422	25.49	3.19		8
9	Stall manure and kainit	23.49	1,365	12.80	1,443	1,791	28.05	3.51	31.25	1,442	11.11	1,257	2,099	30.96	3.87		9
12	Yard manure and gypsum	19.02	1,014	11.60	1,152	902	22.05	2.76	26.54	1,126	10.46	1,037	1,178	25.30	3.16		12
13	Stall manure and gypsum	22.37	1,344	12.44	1,310	1,164	25.76	3.22	29.61	1,165	11.07	1,068	1,535	28.53	3.57		13
15	Yard manure, untreated	14.70	744	8.21	887	636	17.00	2.12	23.12	765	9.83	971	1,212	24.08	3.01		15
16	Stall manure, untreated	19.38	1,076	9.73	1,024	1,191	22.94	2.87	26.18	908	11.01	1,179	1,847	29.21	3.65		16
18	Fertilizer[2]	6.65	399	2.41	253	639	0.45	....	14.01	502	6.55	575	299	5.96	....		18
19	Fertilizer[3]	7.78	302	4.05	383	703	6.10	....	12.21	458	4.53	587	556	8.11	....		19

[1]Estimating floats at $7.50 per ton, acid phosphate at $11.50, kainit at $11.50, and gypsum at $4.50 in bulk carloads, freight paid to Wooster, with $2.50 per ton additional to cover cost of hauling to the farm and applying. Equivalent to $1.60 per acre for treatment with floats, $2.24 for acid phosphate and kainit, and $1.12 for gypsum. These costs are deducted from the total value of the increase, which is found by rating corn at 40 cents per bushel, wheat at 80 cents, hay at $8.00 per ton, stover at $3.00 and straw at $2.00,

[2]No manure; acid phosphate, 80 lbs.; muriate potash, 80 lbs.; nitrate soda, 160 lbs.

[3]No manure: acid phosphatp, 80 lbs.; muriate potash, 10 lbs.; tankage, 100 lbs.

TABLE XIX: Barnyard manure on crops grown in 3-year rotation
Average annual increase per acre for entire period of experiment and its value (excluding corn crop of 1909)

Plot No.	Manure and treatment	Average annual increase per acre					Cost of treatment per acre	Net value of increase	
		Corn 16 crops		Wheat 16 crops		Hay 13 crop Lbs.		Per acre for one rotation	Per ton of manure
		Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.				
2	Yard manure and floats	25.11	1,181	12.49	1,216	1,719	$1.60	$28.30	$3.54
3	Stall manure and floats	31.38	1,489	14.37	1,469	2,399	1.60	35.75	4.47
5	Yard manure and acid phos.	31.47	1,299	14.79	1,485	2,040	2.24	33.77	4.22
6	Stall manure and acid phos.	35.53	1,542	15.67	1,653	2,661	2.24	39.12	4.89
8	Yard manure and kainit	24.73	1,247	10.60	1,128	1,248	2.24	24.12	3.01
9	Stall manure and kainit	28.84	1,489	12.06	1,361	1,933	2.24	30.27	3.78
12	Yard manure and gypsum	23.97	1,127	11.10	1,108	1,029	1.12	24.26	3.03
13	Stall manure and gypsum	27.39	1,339	11.84	1,204	1,335	1.12	27.86	3.48
15	Yard manure, untreated	19.83	801	8.92	924	902	....	20.80	2.60
16	Stall manure, untreated	23.99	1,059	10.29	1,092	1,494	....	26.48	3.31
18	Chemical fertilizer[1]	10.74	475	4.22	394	482	7.45	3.26	....
19	Chemical fertilizer[2]	10.48	400	4.26	472	635	2.30	8.91	....

[1]Acid phosphate, 80 lbs.; muriate of potash, 80 lbs.; nitrate of soda, 160 lbs.
[2]Acid phosphate, 80 lbs.; muriate of potash, 10 lbs.; tankage (7-30) 100 lbs.

In 1905 Section B in this test received a dressing of caustic lime, applied at the rate of a ton to the acre and spread over all the land, manured and unmanured alike, after the land had been plowed for corn. In 1906 and 1907 Sections A and C were dressed with ground limestone, used at the rate of two tons per acre and likewise spread over all the land after plowing for corn. In 1911, 1912 and 1913 ground limestone was again used, at the rate of nearly two tons per acre in 1911 and at a little less than one ton in 1912 and 1913.

To this liming has been due the superior growth of clover during the second period of this test, as shown in Table XVIII, and in part, at least, that of wheat. The inferior yield of corn during this period has apparently been chiefly due to grub worms, which injured the crop so seriously in 1909 that no comparison could be made, and have caused some injury in other seasons.

It will be observed that all the manure applications, treated and untreated, show a greater effect during the second period than during the first, the rate of gain being considerably greater in the case of the manure treated with acid phosphate than from any other treatment.

V: LIME AND FLOATS TEST

This experiment was begun in 1905 in a 3-year rotation of corn, oats and clover, for the purpose of comparing the effect of different forms of lime and of obtaining further experience in the use of untreated phosphate rock.

The land had been under the regular rotative cropping of the farm since its occupation by the Station, and for a considerable period before, and was in good condition. Twelve tons of manure per acre had been plowed under for corn in 1904. Three sections of 26 plots each are included in the test, the plots containing one-twentieth acre each.

For the crops of 1905 Section A (north end) was manured at the rate of 6 tons per acre only, because of the recent application above mentioned, limed and fertilized and planted in corn. Section B was sown to soybeans instead of clover, the beans to be followed by rye in the fall and corn in 1906. Section C (south end) was limed and fertilized without manure and sown to oats and clover. Thenceforth the manure, lime and fertilizers have all been applied to the corn crops, the manure being plowed under and the lime and fertilizers applied on the surface. The oats and clover receive no treatment.

The clover seeding failed in 1906, 1908 and 1909, and soybeans were grown instead and harvested as hay. As the soybean suffers less from lack of lime than clover the result has been a smaller apparent effect from the lime than might otherwise have been found.

The plan of treatment and average results of the work for the first nine years are given in Table XX.

The 9-year average yield of the unmanured and unfertilized land in this experiment has been 51.50 bushels of corn, 44.94 bushels of oats and 2 tons of hay per acre. Over such yields the increase from treatment would be expected to be relatively small. It appears, however, that the applications of manure are being made with profit, and that the supplementing of manure with lime is further increasing the yield. When preceded by manure, ground limestone on Plot 6 is apparently producing a greater total and net gain than an equivalent quantity of caustic lime on Plot 3, or of hydrated lime on Plot 8. When used in the absence of manure, however, caustic lime is followed by a larger total and net gain on Plot 14 than ground limestone on Plot 15.

While the yield on the land receiving 1,000 pounds of floats, applied to the surface after the manure has been plowed under, is greater than that on the land similarly treated with gypsum, in neither case is the effect at all comparable with that observed in the barnyard manure test, previously reported, in which one-third this quantity of these materials is mixed with the manure before application. Nor is the effect on clover of either floats or gypsum equal to that of lime or ground limestone.

When used in the absence of manure and as a direct application to the land, 320 pounds of floats has produced a much smaller net gain than the same quantity of acid phosphate costing twice as much, as shown in the triplicate comparison of Plots 17 and 18, 20 and 23, and 21 and 24.

So far, therefore, as the results of this experiment may be accepted, they support other experiments of this Station in showing that ground limestone should be used only as a supplement to liberal manuring or fertilizing, and floats only as a reinforcement of manure, and that neither should be regarded as a substitute for manure or fertilizers.

TABLE XX: CROPS GROWN IN 3-YEAR ROTATION UNDER TREATMENT WITH MANURE, LIME AND FLOATS

Average yield and increase for 9 years, 1905-1913 inclusive

Plot No.	Treatmeut (Lime, manure, etc., per acre applied to corn only)	Yield per acre					Increase per acre					Total value of increase	Cost of treatment excluding mauure	Net gain or loss (—) per acre	Gain per ton of manure	Pl't No.
		Corn, 9 years		Oats, 9 years			Corn		Oats							
		Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Hay 8 yrs. Lbs.	Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Hay 8 yrs. Lbs.					
1	None	52.57	2,804	43.16	2,267	4,201										1
2	Caustic lime, 500 lbs.; manure, 8 tons	70.42	3,500	50.98	2,502	5,313	17.57	670	6.66	294	1,030	$14.44	$1.50	$12.94	$1.62	2
3	Caustic lime, 1,000 lbs.; manure, 8 tons	72.62	3,584	51.20	2,477	5,470	19.48	728	5.72	329	1,105	15.35	3.00	12.35	1.54	3
4	None	53.42	2,882	46.64	2,089	4,447										4
5	Caustic lime, 2,000 lbs.; manure, 8 tons	75.95	3,833	52.70	2,536	5,933	21.80	930	5.96	441	1,470	18.22	6.00	12.22	1.53	5
6	Ground limestone, 1,780 lbs.; manure, 8 tons	75.14	3,649	53.08	2,526	5,634	20.26	724	6.24	426	1,156	16.11	2.70	13.41	1.68	6
7	None	55.61	2,974	46.93	2,104	4,492										7
8	Air slaked lime, 1,780 lbs.; manure, 8 tons.	74.74	3,809	53.75	2,628	5,766	19.84	902	7.43	551	1,393	17.64	5.30	12.34	1.54	8
9	Hydrated lime, 1,320 lbs.; manure, 8 tons.	71.70	3,722	53.53	2,617	5,520	17.52	856	7.84	567	1,265	16.27	4.00	12.27	1.53	9
10	None	53.46	2,827	45.08	2,022	4,135										10
11	Gypsum, 1,000 lbs.; manure, 8 tons	67.28	3,387	51.86	2,268	4,605	15.10	611	6.87	295	566	11.58	3.00	8.58	1.07	11
12	Floats, 1,000 lbs.; manure, 8 tons	67.43	3,387	53.42	2,383	4,768	16.54	661	8.54	459	827	13.94	4.50	9.44	1.18	12
13	None	49.60	2,676	44.78	1,876	3,844										13
14	Caustic lime, 1,000 lbs.	57.33	3,149	47.53	2,079	4,580	7.74	461	2.63	218	771	7.88	3.00	4.88	....	14
15	Ground limestone, 1,780 lbs	54.84	2,820	45.35	1,876	4,362	5.26	121	.32	28	588	4.76	2.70	2.06	....	15
16	None	49.58	2,711	45.14	1,833	3,738										16
17	Caustic lime, 1,000 lbs.; acid phos, 320 lbs.; muriate potash, 40 lbs.	70.45	3,558	50.55	2,061	5,084	20.13	829	5.40	202	1,264	16.17	6.60	9.57	....	17
18	Caustic lime, 1,000 lbs.; floats, 320 lbs.; muriate potash, 40 lbs.	66.43	3,438	48.35	1,972	4,991	15.36	691	3.18	87	1,091	12.58	5.45	7.13	....	18
19	None	51.81	2,764	45.19	1,911	3,981										19
20	Acid phosphate, 320 lbs.	60.18	3,056	46.16	1,912	4,277	8.55	315	1.19	37	271	5.37	2.60	2.77	....	20
21	Acid phos., 320 lbs.; mur. of potash, 40 lbs.	66.22	3,327	47.88	2,014	4,443	14.78	611	3.14	176	413	9.60	3.60	6.00	....	21
22	None	51.27	2,691	44.52	1,802	4,055										22
23	Floats, 320 lbs.	53.58	2,742	45.17	1,842	4,060	4.06	104	1.16	57	104	2.60	1.45	1.15	....	23
24	Floats, 320 lbs.; muriate of potash, 40 lbs.	56.63	3,016	44.80	1,808	3,912	8.87	431	1.31	42	54	4.84	2.45	2.39	....	24
25	None	46.01	2,531	42.98	1,749	3,759										25
26	Manure, 8 tons since 1909*	55.97	3,049	46.56	1,951	4,475	17.34	816	3.58	202	715	12.30	....	....	....	26
	Average unfertilized yield	51.50	2,759	44.94	1,961	4,074										

*Previously, floats, 320 lbs.; muriate potash, 40 lbs.; dried blood, 100 lbs.

Notice: The lime or gypsum or floats and manure are not mixed together. The manure is plowed under and the lime or other materials applied to the surface.

VI: THE STRONGSVILLE EXPERIMENTS

The experiments now in progress at Strongsville include a 5-year rotation of corn, oats, wheat, clover and timothy, begun in 1895, and a 3-year rotation of corn, wheat and clover, begun in 1905.

THE 5-YEAR ROTATION

The plan of fertilizing in this rotation is the same as in the similar rotation at Wooster as far as Plot 30, with the addition of 10 plots, treated as shown in Diagram V. The results are given in Tables XXI and XXII.

DIAGRAM V: CONTINUATION OF DIAGRAM II. PLAN OF FERTILIZING IN 5-YEAR ROTATION AT STRONGSVILLE

Plots one-tenth acre — Fertilizers in pounds per acre

Plot No.	On corn			On oats			On wheat			
	Acid phosphate	Muriate of potash	Nitrate of soda	Acid phosphate	Muriate of potash	Nitrate of soda	Acid phosphate	Muriate of potash	Dried blood	Nitrate of soda
31	.. .	....	....	....	....	..	....	....	....	....
32	80	80	80	80	80	80	160	100	25	60
33	80	80	40	80	80	40	160	100	15	30
34	.. .	....	....	....	....	....	....	....	....	....
35	80	40	160	80	40	160	160	50	50	120
36	80	20	160	80	20	160	160	25	50	120
37	....	....	....	....	....	....	....	....	....	....
38	....	....	....	....	....	....	100	10	*	.. .
39	....	....	....	.. .	....	....	**	....	....	....
40	....	....	....	....	....	....	....	..	....	....

*7-30 tankage, 100 lbs. **Barnyard manure, 16 tons.

TABLE XXI: CROPS GROWN IN 5-YEAR ROTATION AT STRONGSVILLE

Yield and increase per acre, 1913. Total fertilizing elements for one rotation

Plot No.	Fertilizing elements			Corn		Oats		Wheat		Hay[1]	Plot No.
	Nitrogen Lbs.	Phosphorus Lbs.	Potassium Lbs.	Grain Bus.	Stover Lbs.	Grain Bus.	Straw Lbs.	Grain Bus.	Straw Lbs.	Clover Lbs.	
Yield per acre											
1	..	..	...	21.64	1,760	29.45	1,207	9.83	910	2,654	1
2	..	20	...	22.64	1,800	39.29	1,602	15.50	1,330	3,599	2
3	..	..	108	8.57	1,200	31.40	1,335	9.37	937	2,743	3
4	..	..	...	7.50	1,080	29.76	1,057	9.87	1,067	2,975	4
5	76	..	...	8.64	1,080	37.03	1,345	10.62	1,152	3,243	5
6	76	20	...	17.64	1,500	47.89	1,627	19.21	1,607	3,750	6
7	..	..	...	13.64	1,390	30.39	1,027	9.04	1,067	3,358	7
8	..	20	108	37.21	2,430	38.83	1,487	15.08	1,315	3,065	8
9	76	..	108	30.14	2,160	37.73	1,372	10.92	1,125	3,270	9
10	..	..	...	28.86	1,850	33.98	1,272	10.27	1,117	2,877	10
11	76	20	108	42.07	2,620	53.51	2,027	17.50	1,560	3,314	11
12	112	20	108	42.14	2,450	54.99	2,000	19.29	1,602	3,581	12
13	..	..	...	20.07	1,670	34.68	1,520	9.04	747	2,691	13
14	50	15	74	30.00	1,940	33.59	1,255	17.00	1,630	3,474	14
15	25	10	41	21.64	1,740	30.39	1,087	16.08	1,575	3,261	15
16	..	..	...	18.57	1,540	32.81	1,010	9.54	687	2,842	16
17	38	30	108	37.93	2,420	51.33	1,957	15.29	1,482	3,831	17
18	144[2]	48	112	38.79	2,350	43.67	1,702	14.16	1,340	4,277	18
19	..	..	...	27.07	2,010	40.00	1,520	9.50	700	2,993	19
20	72[3]	24	56	35.21	2,290	45.15	1,975	11.62	1,152	3,697	20
21	38	30	108	37.79	2,560	57.19	1,970	8.66	880	2,967	21
22	..	..	...	21.71	1,730	39.21	1,685	8.83	840	3,162	22
23	38	30	108	32.21	2,280	57.65	2,155	15.37	1,407	3,751	23
24	38	30	108	32.50	2,470	54.06	1,890	13.95	1,252	3,644	24
25	..	..	...	20.86	1,760	36.17	1,462	4.87	817	3,270	25
26	76	20	108	35.71	2,400	49.06	1,710	13.66	1,200	3,662	26
27	76	20	108	28.29	2,250	41.64	1,417	14.83	1,280	3,671	27
28	..	..	...	16.36	1,460	27.73	952	7.37	797	3,109	28
29	76	20	108	27.43	1,960	47.73	1,572	16.53	1,408	3,581	29
30	38	30	108	28.93	2,230	42.18	1,480	17.21	1,507	3,661	30
31	..	..	...	15.57	1,640	34.21	1,295	6.00	720	2,753	31
32	38	20	108	30.00	2,330	43.90	1,405	13.54	1,307	3,059	32
33	19	20	108	36.14	2,290	44.29	1,532	11.41	1,205	3,581	33
34	..	..	...	24.00	1,840	27.18	1,030	7.17	780	2,200	34
35	76	20	54	45.57	2,600	51.56	1,655	14.12	1,202	3,171	35
36	76	20	27	41.57	2,420	47.65	1,575	13.83	1,300	3,617	36
37	..	..	...	26.36	2,100	31.40	1,155	3.54	687	2,993	37
38	..	6¼	4	27.43	2,100	28.83	987	10.71	1,037	3,412	38
39	144[4]	48	112	29.29	1,150	36.71	1,105	7.92	855	4,454	39
40	..	..	...	13.14	1,560	27.03	1,005	5.79	772	2,975	40
Average unfertilized yield...				19.66	1,670	32.43	1,228	7.91	836		
Increase per acre											
2	..	20	...	5.71	267	9.73	445	5.66	367	838	2
3	..	..	108	−3.64	−107	1.74	228	−.49	−78	−125	3
5	76	..	...	−.91	−103	7.06	297	1.03	85	140	5
6	76	20	...	6.05	213	17.71	590	9.89	540	520	6
8	..	20	108	18.50	887	7.24	378	5.60	230	−133	8
9	76	..	108	6.35	463	4.94	183	.99	25	232	9
11	76	20	108	16.14	830	19.29	672	7.57	566	499	11
12	112	20	108	19.14	720	20.54	562	9.81	731	828	12
14	50	15	74	10.43	313	−.46	−95	7.79	903	733	14
15	25	10	41	2.57	157	−3.04	−92	6.71	868	469	15
17	38	30	108	16.53	723	16.12	777	5.77	791	939	17
18	144	48[2]	112[2]	14.55	497	6.07	352	4.65	644	1,334	18
20	72	24[3]	56[3]	9.93	373	5.42	400	2.35	405	648	20
21	38	30	108	14.29	737	17.71	340	−.39	87	−139	21
23	38	30	108	10.78	540	19.45	544	7.86	575	553	23
24	38	30	108	11.36	720	16.87	353	7.76	427	410	24
26	76	20	108	16.35	740	15.70	417	7.95	389	446	26
27	76	20	108	10.43	690	11.10	295	8.29	476	508	27
29	76	20	108	11.33	440	17.84	506	9.62	636	591	29
30	38	30	108	13.10	650	10.13	299	10.75	761	789	30
32	38	20	108	11.62	623	12.03	198	7.15	567	490	32
33	19	20	108	14.95	517	14.76	414	4.63	445	1,197	33
35	76	20	54	20.78	673	22.97	583	8.16	453	707	35
36	76	20	27	16.00	407	17.65	461	9.08	581	888	36
38	..	6¼	4	5.48	180	−1.12	−117	6.42	322	425	38
39	144	48	112	11.74	410	8.23	50	2.88	110	1,473	39

[1]The timothy crop was a failure.
[2]Estimated: (Barnyard manure, 16 tons, 8 tons each on corn and wheat.)
[3]Estimated: (Barnyard manure, 8 tons, 4 tons each on corn and wheat.)
[4]Estimated: (Barnyard manure, 16 tons, all on wheat.)

TABLE XXII: CROPS GROWN IN 5-YEAR ROTATION AT STRONGSVILLE

Average annual yield and increase per acre for the 19 years, 1894-1913

Plot No.	Fertilizing elements			Corn—19 yrs.		Oats—18 yrs.		Wheat—15 yrs.		Hay		Plot No.
	Nitrogen Lbs.	Phosphorus Lbs.	Potassium Lbs.	Grain Bus.	Stover Lbs.	Grain Lbs.	Straw Lbs.	Grain Bus.	Straw Lbs.	Clover 17 yrs. Lbs.	Timothy 9 yrs. Lbs.	
Yield per acre												
1	..	..	...	22.57	1,547	33.07	1,286	5.72	627	1,682	2,290	1
2	..	20	...	30.57	1,732	42.46	1,580	12.48	1,242	2,584	2,481	2
3	..	..	108	22.18	1,606	33.43	1,277	5.77	577	1,699	1,977	3
4	..	..	...	20.92	1,462	33.06	1,189	6.55	666	1,602	2,044	4
6	76	..	...	23.86	1,613	34.16	1,291	6.39	667	1,933	2,176	5
6	76	20	...	34.04	1,834	46.11	1,730	16.02	1,547	2,649	2,585	6
7	..	..	...	25.86	1,672	34.68	1,334	6.58	697	2,032	2,215	7
8	..	20	108	36.35	2,013	45.41	1,812	14.68	1,305	2,634	2,751	8
9	76	..	108	29.26	1,852	39.41	1,572	9.12	940	2,233	2,406	9
10	..	..	...	27.04	1,699	37.33	1,435	8.21	799	1,970	2,459	10
11	76	20	108	38.69	2,187	50.68	1,981	17.31	1,692	2,820	2,956	11
12	112	20	108	38.55	2,184	50.50	1,882	19.42	1,896	2,774	2,780	12
13	..	..	...	26.08	1,699	37.53	1,466	7.89	784	1,975	2,439	13
14	50	15	74	34.88	2,056	41.12	1,566	17.45	1,697	2,772	2,748	14
15	25	10	41	28.10	1,725	36.65	1,409	16.01	1,544	2,564	2,515	15
16	..	..	...	26.80	1,720	34.82	1,305	8.10	742	2,021	2,362	16
17	38	30	108	38.54	2,155	49.63	1,893	15.96	1,465	2,911	2,802	17
18	144[1]	48[1]	112	39.99	2,268	43.14	1,697	15.32	1,545	2,965	2,913	18
19	..	..	...	25.74	1,772	35.61	1,313	6.60	626	1,982	2,379	18
20	72[2]	24[2]	56[2]	34.31	2,076	41.24	1,645	11.94	1,213	2,765	2,802	20
21	38	30	108	36.35	2,196	51.24	2,071	16.44	1,596	2,850	2,880	21
22	..	..	...	27.34	1,812	39.60	1,616	8.48	832	2,249	2,421	22
23	38	30	108	37.89	2,160	51.82	2,169	16.54	1,611	2,897	2,950	23
24	38	30	108	36.68	2,218	51.64	2,131	16.86	1,623	2,887	2,890	24
25	..	..	...	27.00	1,834	37.55	1,514	7.54	767	2,050	2,348	25
26	76	20	108	35.96	2,182	48.13	1,895	17.43	1,629	2,963	2,760	26
27	76	20	108	34.36	2,117	48.23	1,872	16.49	1,584	2,659	2,389	27
28	..	..	...	24.49	1,696	34.97	1,280	7.79	767	1,912	2,161	28
29	76	20	108	35.88	2,103	47.04	1,784	17.46	1,667	2,732	2,605	29
30	38	30	108	40.97	2,206	48.21	1,781	17.42	1,625	3,012	2,893	30
31	..	..	...	24.81	1,715	34.31	1,351	7.24	710	1,877	2,210	31
32	38	20	108	34.23	2,097	46.63	1,806	15.63	1,476	2,738	2,553	32
33	19	20	108	34.74	2,069	46.00	1,788	15.57	1,354	2,774	2,617	33
34	..	..	...	23.89	1,691	33.04	1,287	6.89	688	1,767	2,090	34
35	76	20	54	35.10	2,057	47.63	1,883	16.24	1,550	2,763	2,535	35
36	76	20	27	36.72	2,152	45.76	1,820	16.40	1,531	2,916	2,555	36
37	..	..	...	26.50	1,734	34.12	1,351	6.21	632	2,048	2,076	37
38	..	6¼	4	30.63	1,911	35.13	1,389	14.00	1,332	2,667	2,580	38
39	144[3]	48[3]	112[3]	30.81	1,872	35.68	1,406	13.09	1,353	3,040	2,816	39
40	..	..	...	23.71	1,640	31.62	1,217	6.16	623	1,860	2,067	40
Average unfertilized yield..				26.09	1,737	35.08	1,360	7.15	713	1,959	2,254	
Increase per acre												
2	..	20	...	8.54	213	9.40	326	6.49	602	928	273	2
3	..	..	108	.71	115	.37	55	—.50	—76	70	—149	3
5	76	..	...	1.29	81	.56	54	—.16	—9	188	75	5
6	76	20	...	9.83	232	11.97	444	9.45	861	760	427	6
8	..	20	108	10.10	332	9.85	444	7.56	574	623	455	8
9	76	..	108	2.61	162	2.96	170	1.45	175	242	29	9
11	76	20	108	11.96	488	13.28	535	9.21	898	849	504	11
12	112	20	108	12.15	485	13.03	426	11.43	1,107	801	335	12
14	50	15	74	8.57	349	4.49	154	9.49	927	782	335	14
15	25	10	41	2.32	40	1.49	81	7.98	788	558	128	15
17	38	30	108	12.09	417	14.55	585	8.36	762	904	434	17
18	144[1]	48[1]	112[1]	13.90	513	7.79	387	8.22	881	970	540	18
20	72[2]	24[2]	56[2]	8.04	290	4.30	231	4.71	519	694	409	20
21	38	30	108	9.54	397	12.96	556	8.58	833	690	473	21
23	38	30	108	10.66	340	12.90	587	8.38	800	714	553	23
24	38	30	108	9.57	391	13.40	582	9.01	834	770	518	24
26	76	20	108	9.80	394	11.44	459	9.81	862	959	475	26
27	76	20	108	9.03	375	12.39	514	8.78	816	701	166	27
29	76	20	108	11.28	401	12.29	480	9.85	918	832	428	29
30	38	30	108	16.27	497	13.67	453	9.99	895	1,123	700	30
32	38	20	108	10.47	319	12.74	477	8.51	773	898	583	32
33	19	20	108	10.92	379	12.54	480	7.56	659	970	487	33
35	76	20	54	10.33	346	14.23	579	9.58	881	902	450	35
36	76	20	27	11.09	433	12.00	490	9.97	880	962	474	36
38	..	6¼	4	5.06	209	1.96	82	7.81	703	682	507	38
39	144[3]	48[3]	112[3]	6.17	200	3.64	190	6.91	727	1,117	746	39

[1]Estimated: (Barnyard manure, 16 tons, 8 tons each on corn and wheat.)
[2]Estimated: (Barnyard manure, 8 tons, 4 tons each on corn and wheat.)
[3]Estimated: (Barnyard manure, 16 tons, all on wheat.)

TABLE XXIII: TOTAL FERTILIZING MATERIALS AND THEIR COST AND TOTAL NET VALUE OF INCREASE PRODUCED FOR 5-YEAR PERIODS AND FOR 19 YEARS ALL CALCULATED FOR ONE ROTATION OF 5 YEARS AT STRONGSVILLE

Plot No.	Fertilizing materials in pounds per acre for each rotation	Cost of fertilizers for each rotation	Average value of total increase per acre for each rotation				Net gain or loss (−) from fertilizers for each rotation				Plot No.
			First 5-years	Second 5-years	Third 5-years	19-year average Total	First 5-years	Second 5-years	Third 5-years	19-year average Net	
2	Acid phosphate, 320	$ 2.60	$14.10	$21.66	$16.04	$17.48	$11.50	$19.06	$13.44	$14.88	2
3	Muriate potash, 260	6.50	.70	.92	−1.25	−.17	−5.80	−5.58	−7.75	−6.67	3
5	Nitrate soda, 440; dried blood, 50	14.40	.77	.77	2.48	1.77	−13.63	−13.63	−11.92	−12.63	5
6	Acid phosphate, 320; nitrate soda, 440; dried blood, 50	17.00	18.13	24.68	22.22	21.48	1.13	7.68	5.22	4.48	6
8	Acid phosphate, 320; muriate potash, 260	9.10	16.47	19.77	22.10	18.87	7.37	10.67	13.00	9.77	8
9	Muriate potash, 260; nitrate soda, 440; dried blood, 50	20.90	3.36	2.90	6.58	4.76	−17.54	−18.00	−14.32	−16.14	9
11	Acid phos., 320; mur. potash, 260; nitrate soda, 440; dried blood, 50	23.50	21.79	24.69	23.71	23.71	−1.71	1.19	.21	.21	11
12	" " 320; " " 260; " " 680; " " 50	30.70	22.33	26.57	24.22	24.72	−8.37	−4.13	−6.48	−5.98	12
14	" " 240; " " 180; " " 280; " " 50	16.05	18.71	19.43	18.39	18.44	2.66	3.38	2.34	2.39	14
15	" " 160; " " 100; " " 120; " " 50	8.60	9.91	13.46	14.24	11.10	1.31	4.86	5.64	2.50	15
17	" " 480; " " 250; " " 220; " " 25	17.60	13.91	28.58	25.26	23.21	3.69	10.98	7.66	5.61	17
18	Yard manure, 16 tons	?	16.65	20.16	25.16	22.55	?	?	?	?	18
20	Yard manure, 8 tons	?	12.56	12.62	21.22	13.87	?	?	?	?	20
21	Same elements as 17, but nitrogen in oilmeal	17.60	18.51	25.05	20.77	21.20	.91	7.45	3.17	3.60	21
23	" " " 17, " " " dried blood	17.60	20.54	24.14	20.63	21.80	2.94	6.54	3.03	4.20	23
24	" " " 17, " " " sulphate ammonia	17.60	20.46	24.93	21.71	22.21	2.86	7.33	4.11	4.61	24
26	" " " 17, " phosphorus in bonemeal	23.50	20.47	26.02	21.59	22.85	−3.03	2.52	−1.91	−.65	26
27	" " " 17, " " " dissolved boneblack	23.50	17.34	24.03	21.22	19.71	−6.16	.53	−2.28	−3.79	27
29	" " " 17, " " " basic slag	23.50	23.19	25.52	21.22	23.12	−.31	2.02	−2.28	−.38	29
30	" " " 17, " nitrogen in tankage	17.60	24.91	35.55	25.39	27.99	7.31	17.95	7.79	10.39	30
32	Acid phos., 320; mur. potash, 260; nitrate soda, 220; dried blood, 25	16.30	20.98	24.38	20.59	21.67	4.68	8.08	4.29	5.37	32
33	" " 320; " " 260; " " 110; " " 15	12.70	20.91	24.53	18.71	21.71	8.21	11.83	6.01	9.01	33
35	" " 320; " " 130; " " 440; " " 50	20.25	20.36	23.98	23.96	23.45	.11	3.73	3.71	3.20	35
36	" " 320; " " 65; " " 440; " " 50	18.62	22.14	26.81	21.37	23.78	3.52	8.19	2.75	5.16	36
38	" " 100; " " 10; tankage (7-30) 100	?	12.23	20.38	13.68	14.71	?	?	?	?	38
39	Yard manure, 16 tons	?	8.38	14.73	22.70	17.77	?	?	?	?	39

The table shows a decidedly greater increase from the fertilizers during the second period than during the first. Beginning with the third period the plots were cross-dressed with lime and floats, fertilized and unfertilized alike, with the result that, while the total yield is increased, the gain for the fertilizers has been smaller than previously. The details of this work are given in Bulletin 260.

Taking the average results for the entire period it will be seen that the effect of acid phosphate, used alone, has been greater at Strongsville than at Wooster, while that from the carriers of nitrogen and potassium has been smaller, and although these carriers have added to the total value of the increase when used in combination with carriers of phosphorus they have not added enough to compensate the increased cost of the fertilizer. During the first 10 years of the test Plot 30 received a larger application of phosphorus than any other one in the series.

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